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THE GENUS MASTIXIODENDRON (RUBIACEAE)

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ALTHOUGH THEY COMPRISE one of the largest angiosperm families, members of the Rubiaceae are remarkably uniform in a number of characters. The principal characters shared by nearly all Rubiaceae include opposite, stipulate, simple, entire leaves; inferior ovaries; and sympetalous corollas with the stamens equaling the corolla lobes in number and inserted alternately with them. Because the family is so easily characterized, taxa which vary from the accepted "norm" are particularly conspicuous. Bremekamp (1966) has pointed out that, although a few genera (e.g., *Gaertnera* Lam. and *Pagamea* Aublet) may possess ovaries which are wholly or partly superior at some stage in their ontogeny, they nonetheless agree with the Rubiaceae in other characters and should be included within that family. Bremekamp rightly cautions that the importance of the inferior ovary (like any other single character) is not to be overrated in determining the limits of the Rubiaceae. Similarly, there are a few Rubiaceae with polypetalous corollas (e.g., *Hedstromia* A. C. Sm.), probably resulting from a progressive shortening of the corolla tube. With regard to other, less diagnostic features, the list of exceptions could be extended considerably.

An especially aberrant genus, but one rarely mentioned as such in the literature, is *Mastixiodendron* Melchior. Its polypetalous corollas and, in at least a few species, its semisuperior ovaries have persistently drawn attention away from other, more recondite features which label the genus as definitely rubiaceous. At various times associated with the Loganiaceae or the Cornaceae, there seems now to be little doubt that *Mastixiodendron* ought to be counted among the Rubiaceae, even though a few of its salient morphological characters might seem anomalous in that family.

HISTORY

The genus *Mastixiodendron* was first described by Melchior (1925) to accommodate *Fagraea pachyclados* K. Schum., a species from New Guinea, described in the Loganiaceae. Primarily on account of its polypetalous corollas, Melchior aligned *Mastixiodendron* with *Mastixia* Blume of the Cornaceae. He was evidently unaware that the transfer of *F. pachyclados*

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to the Cornaceae had earlier been suggested by Gilg and Schlechter (in Gilg & Benedict, 1916, p. 197), although *Fagraeopsis*, the generic name which they proposed, was a provisional name. Melchoir described the morphology and anatomy of *Mastixiodendron* in some detail, enumerating the characters by which it differs from other Cornaceae.

Gillespie (1933) described *Dorisia rarissima* as a new genus and species of Cornaceae from Fiji. He noted a close similarity among *Dorisia*, *Mastixia*, and *Mastixiodendron*, the first genus being distinct in its almost entirely inferior ovaries. A few years later, *Dorisia* was reinvestigated by Smith (1936, p. 140), who, in spite of its separate corolla lobes, regarded the genus as entirely rubiaceous in its vegetative characters. With supporting evidence from wood anatomy and stomatal structure, he removed *Dorisia* from the Cornaceae and placed it in the tribe Chiococceae of the Rubiaceae.

Danser (1934, p. 69) was the first author to suggest that the New Guinean species of *Mastixiodendron* be transferred from the Cornaceae to the Rubiaceae, an alignment suggested to him by the large, imbricate stipules which are otherwise unknown in the former family. On the basis of leaf and stem structure, Merrill and Perry (1942, p. 416) independently reached the same conclusion and reiterated the close similarity between *Mastixiodendron* and *Dorisia*.

The union of *Dorisia* with *Mastixiodendron* was effected by Smith (1945, p. 108), who, at the same time, added another Fijian species, *M. pilosum*. Soon after, Merrill and Perry (1945, p. 254) described two additional species, *M. smithii*, from New Guinea, and *M. stoddardii*, from the Solomon Islands. A sixth species, *M. robustum*, from Fiji, was later described by Smith (1969, p. 390).

GEOGRAPHICAL DISTRIBUTION

As interpreted here, *Mastixiodendron* includes seven species: *M. pachyclados*, distributed from the Moluccas eastward through New Guinea and the Bismarck Archipelago; *M. smithii* and *M. plectocarpum*, in New Guinea; *M. stoddardii*, in the Bismarck Archipelago and the Solomon Islands; and *M. flavidum*, *M. pilosum*, and *M. robustum*, all endemic to to Fiji. The genus has a distributional pattern which, common among flowering plants of the western Pacific (Smith, 1955), is termed "East Malesian" by van Balgooy (1971).

MORPHOLOGY

HABIT AND DURATION. All species of *Mastixiodendron* are woody; many are large forest trees, while others (*M. flavidum*) are slender trees or large shrubs. The crowns of the arborescent species are variable, but are usually small, dense, and rounded, with heavy, ascending limbs. In some species (*M. smithii*, *M. stoddardii*), the bole is frequently poorly formed.

BARK AND WOOD. Where field notes are available (mostly for collections from New Guinea), the outer bark is described as "pustular" or "flaking," often being shed as relatively large, papery pieces. Such features may be of value in the field identification of the genus. The wood of *Mastixiodendron* is usually described as being hard; it is white to pale brown in color, although darkening on exposure.

The wood anatomy of the genus is reasonably uniform. The vessels are occasionally solitary, but are more often radially aligned in groups of as many as five, rarely more, and with more than 40 vessels per square millimeter of cross sectional area. The vessel elements have simple perforations and diameters from 0.05 mm. (branchlet of *M. pachyclados*, *Brass & Versteegh 13548*) to 0.13 mm. (*M. stoddardii*, *Stoddard 12*). Wood fibers are conspicuously septate, and the pits are generally confined to the radial walls. The rays are multiseriate, heterogeneous, up to four cells wide (*M. stoddardii*), and variable in height from 0.4 mm. (*M. flavidum*, *A. C. Smith 1932*) to 1.25 mm. (*M. stoddardii*); extended uniseriate wings or sheath cells are absent. Axial parenchyma is also absent.

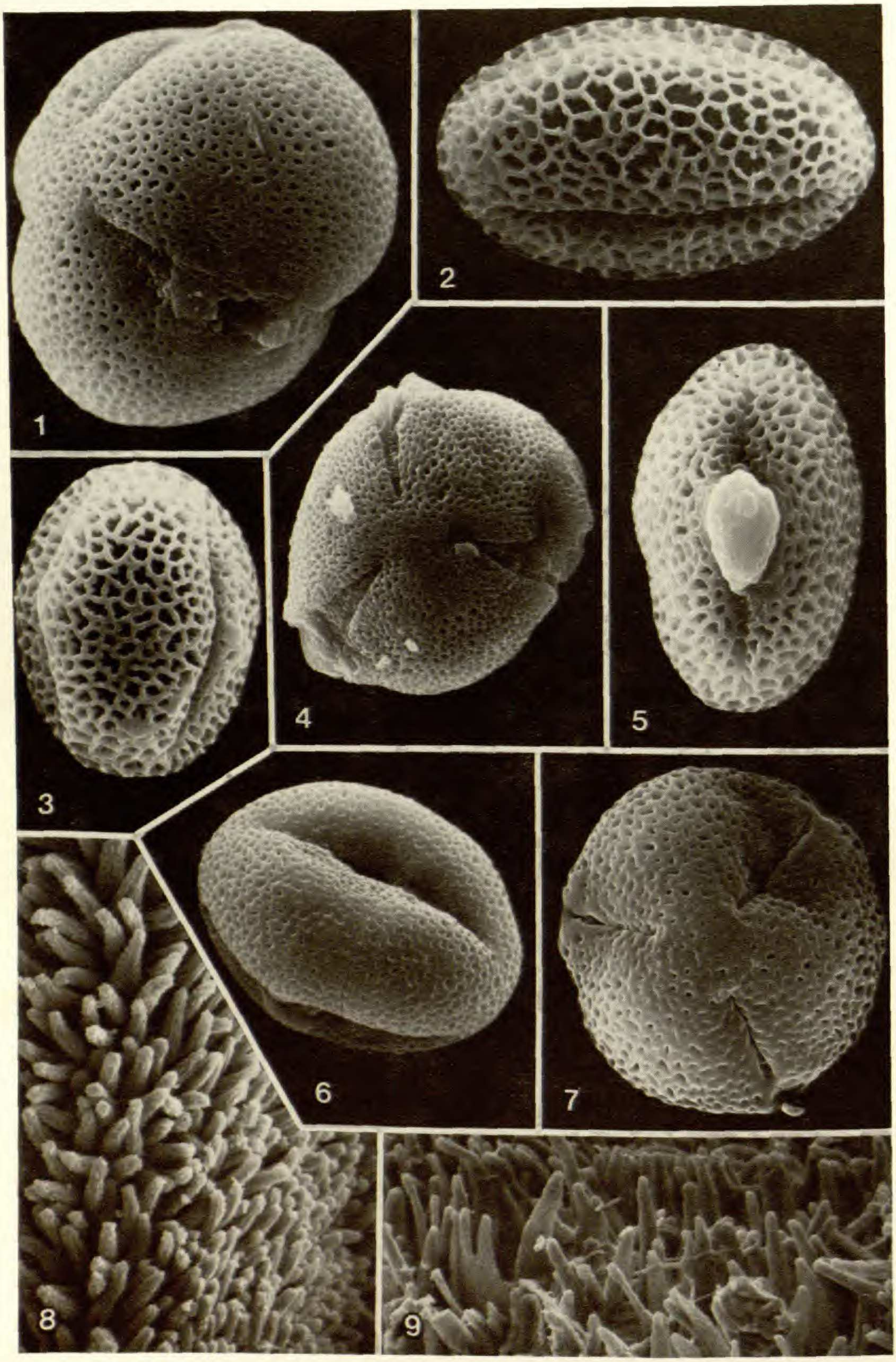
HAIRS. Trichomes of various size are always present on the inner surfaces of the corolla lobes. The corolla hairs are unicellular, as is usual in the Rubiaceae, and have smooth to somewhat striate walls. Minute hairs are also present on other inflorescence and flower parts. Only *Mastixiodendron pachyclados* var. *tomentosum* and *M. pilosum* have significant indument on their vegetative parts; epidermal hairs (FIGURES 10, i; 14, f) from their leaf blades have smooth to finely striate and frequently thick outer walls (especially in *M. pilosum*). The lumina of the longer hairs are traversed by as many as ten thin septa.

CRYSTALS. I have observed crystal sand in leaf tissues. Raphides are absent.

LEAVES AND STIPULES. The simple, entire leaves of *Mastixiodendron* are opposite at each node. The leaf blades are coriaceous (thickly so in *M. robustum*) to chartaceous (*M. stoddardii* and *M. pilosum*). The secondary nerves are usually fewer than 15 on each side of the costa, except in *M. plectocarpum* and *M. robustum*, where there are frequently as many as 20 (in the former species they are prominulous above and beneath and often hardly discernible from the tertiary nerves). The stomata (FIGURE 14, a), restricted to the lower surfaces of the leaf blades and much crowded, are paracytic, although the narrow accessory cells are often difficult to see.

The petioles of *Mastixiodendron pachyclados* have a vascular pattern common for the Rubiaceae, consisting of a median strand appearing in cross section as a deep arc with its ends strongly incurved around four "medullary" strands; a number of "accessory" strands are located toward the petiole wings (*Brass 14097*).

The imbricate, interpetiolar stipules are prominent in the terminal buds (FIGURE 10, a, b), but soon fall away leaving conspicuous scars. In all species the stipules may be strongly contorted.



FIGURES 1–9. Scanning electron micrographs from species of *Mastixiodendron*. 1–7, pollen grains: 1, *M. smithii*, × 2000 (from *NGF 29193 (Henty & Coode)*); 2, *M. flavidum*, × 2000 (from *A. C. Smith 6365*); 3, *M. robustum*, × 2000 (from *Fiji Dept. Agr. 486*); 4, *M. stoddardii*, × 1200 (from *BSIP 10159 (Gafui*

INFLORESCENCES. The inflorescences of *Mastixiodendron* are axillary thyrses, although there is considerable variation in size, degree of branching, and number of flowers, all characters that may be species-specific. The bracts are similar in all species; there are usually four at the first node (two bracts and two stipules?), but two at the others. Each inflorescence branch terminates in a dichasium (FIGURES 12, c; 13, b; 14, c, h). A pair of small bracts is always present on the axis which supports each of the lateral flowers of the dichasium; in determining the length of the pedicels of these lateral flowers, I have measured only the distance above the bract pair.

COROLLA. The corolla buds of *Mastixiodendron* are usually 4-angled shortly before anthesis and vary in shape from subglobose (*M. pachyclados*, *M. flavidum*, *M. robustum*) to decidedly longer than broad (*M. smithii*, *M. plectocarpum*, *M. pilosum*). At anthesis, the corolla lobes are always entirely free, but vary considerably in size and shape. As stated previously, they are always pubescent to some degree (pilose in most species to papillate in *M. flavidum*) on their inner surfaces, and glabrous to densely puberulent (*M. smithii*) beneath. The lobes are fleshy, and in *M. pachyclados* there are often shallow depressions on the inner surfaces which partially enclose the stamens in bud.

POLLEN. The microspores of *Mastixiodendron* are tricolporate (the colpi and ora well developed). They range in size from 20–25 × 28–33 μm. (*M. smithii*) to 12–15 × 20–23 μm. (*M. robustum*), and in shape from prolate to oblate. The grains are tectate, although those of Papuasian species (FIGURES 1, 4, 6, 7) are tectate-perforate, whereas pollen of the Fijian taxa (FIGURES 2, 3, 5) is semitectate.

GYNOECIUM. The ovaries of *Mastixiodendron* vary from nearly ¾ superior (*M. stoddardii*) to wholly inferior (*M. plectocarpum*). The superior portion of the ovary is here referred to as the "disc," although it is apparently not glandular. The discs are usually glabrous, but are obscurely puberulent in *M. smithii* and *M. plectocarpum* (FIGURES 8, 9). They vary in shape from broad and flat (*M. plectocarpum*), to rounded (*M. pachyclados*, *M. flavidum*, *M. robustum*), to broadly ovoid (*M. stoddardii*), to subconical (*M. smithii*, *M. pilosum*).

FRUITS AND SEEDS. Fruits of *Mastixiodendron* are all drupaceous and indehiscent. They may be mostly superior (*M. stoddardii*), about half superior (e.g., *M. pachyclados*), or inferior (e.g., *M. plectocarpum*), as suggested by the persistent perianth scar. Similarly, the apices vary from sharply pointed (e.g., *M. stoddardii*) to broadly rounded (*M. plectocar-*

et al.)); 5, *M. pilosum*, × 2000 (from *Fiji Dept. Agr. 17094*); 6, *M. pachyclados* var. *pachyclados*, × 2000 (from *NGF 29673 (Coode & Cropley)*); 7, *M. plectocarpum*, × 2000 (from *BW 13347 (Schram)*). 8, 9, surfaces of floral discs showing trichomes: 8, *M. smithii*, × 260 (from *NGF 29193 (Henty & Coode)*); 9, *M. plectocarpum*, × 260 (from *Pullen 7327*).

pum). The pericarp is also variable. The exocarp is a thin skin, the mesocarp a fleshy (when alive) to firm layer; the endocarp may be hard and bony or woody, or fibrous and conspicuously cancellate. Relatively thin pericarps with bony endocarps characterize fruits of *M. pachyclados* and *M. stoddardii*. The fruits of *M. robustum* are hard and woody; those of *M. smithii*, woody to fibrous and more distinctly cancellate with resin cavities. The fruits of *M. plectocarpum* are very strongly cancellate and fibrous.

The solitary ovules of *Mastixiodendron* are often somewhat compressed and apparently pendulous; a slightly thickened apical funiculus is discernible, but each ovule adheres to the elongate placenta over most of its length (as do the mature seeds). The placenta is variably swollen beneath each ovule and projects from the dissepiment (evidently the "flap" of tissue figured by Gillespie, 1933, for *M. flavidum*).

FAMILIAL RELATIONSHIPS

Although Melchior (1925) associated *Mastixiodendron* with *Mastixia*, he nevertheless pointed out numerous anatomical differences between those genera, particularly the distribution in the stem cortex of collenchyma, stone cells, fibers, and secretory cells. However, he overlooked the narrow accessory cells and the paracytic ("rubiaceous") structure of the stomata of the present genus and failed to realize that the characters of wood anatomy alone exclude *Mastixiodendron* from an alliance with *Mastixia* or the Cornaceae as a whole, a family in which the vessels are almost always solitary and have scalariform perforation plates with many bars (Metcalfe & Chalk, 1950). Danser (1934, p. 69) further emphasized the large interpetiolar stipules of *Mastixiodendron* as a rubiaceous character, the Cornaceae being exstipulate. Significant morphological characters and the bulk of anatomical evidence therefore suggest that *Mastixiodendron*, in spite of its free corolla lobes and partially superior ovaries, be included within the Rubiaceae.

TRIBAL RELATIONSHIPS

The characters which define infrafamilial taxa in the Rubiaceae have been discussed by Verdcourt (1958) and Bremekamp (1966); interested readers should consult those studies for a re-evaluation of the earlier classification schemes. I agree that the characters employed by Verdcourt and Bremekamp (e.g., the presence or absence of raphid crystals, thin-walled multicellular hairs, and seed endosperm) seem to correlate well with the more traditional subfamilial and tribal characters, among which are the number and position of the ovules, the nature of the fruit, the aestivation of the corolla lobes, and the place of attachment of the stamens.

Because it has endospermous seeds, valvate corolla aestivation, and thick-walled septate hairs, but lacks raphid crystals, *Mastixiodendron* is assignable to the subfamily Cinchonoideae Raf. *sensu* Verdcourt (1958).

I have reviewed the tribes placed in that subfamily by Verdcourt, and in the subfamilies other than the raphid-possessing Rubioideae by Bremekamp, but have not found any tribe which matches the characters of *Mastixiodendron* in all respects. The most likely candidates are the Alberteae Hooker f., Vanguerieae Dumort., and Chiococceae Hooker f., all of which have solitary, pendulous ovules. However, the Alberteae have corolla lobes which are contorted in bud, and the Vanguerieae and Chiococceae are characterized by conspicuously swollen stigmas and an "ixoroid" pollen presentation mechanism (Bremekamp, 1966), all characters conspicuously absent in *Mastixiodendron*. In addition, the Vanguerieae all have porate pollen and seem to be a group of closely related genera (Verdcourt, 1958).

When Smith (1936, p. 140) placed *Mastixiodendron* (*Dorisia*) in the Rubiaceae, he assigned the genus to the tribe Chiococceae, indicating a possible relationship with *Hodgkinsonia* F. Mueller, from Australia. In the tribal key provided by Schumann (1891), *Mastixiodendron*, with its solitary, pendulous ovules, and stamens attached at the base of the corolla tube (in this case the tube is absent), easily keys to the Chiococceae. Of the genera placed by Schumann in that tribe, only *Hodgkinsonia* is palaeotropical; the other nine genera occur in the New World and show little similarity to the present genus. *Hodgkinsonia* resembles *Mastixiodendron* in its frequently 4-merous flowers, valvate corolla lobes, short styles, axillary inflorescences, indehiscent fruits, and caducous stipules. However, flowers of the former genus are definitely sympetalous, the corolla is not especially fleshy, the stamens are inserted on the corolla tube, and the inflorescences are umbelliform. The wood of *Hodgkinsonia* resembles that of *Mastixiodendron* in that the vessels are of nearly the same size and occur in radial groups; the rays are also multiseriate, to four cells wide, and heterogeneous, although in the former genus diffuse axial parenchyma is present, the fibers are not septate, and the rays have long, uniseriate wings.

I have little doubt that *Mastixiodendron* belongs to the Rubiaceae subfamily Cinchonoideae. As to tribal position, the genus seems best placed in the Chiococceae. Smith's suggested relationship between *Mastixiodendron* and *Hodgkinsonia* appears unlikely to me, but I cannot offer a more plausible suggestion at this time. As genera of the Rubiaceae are reinvestigated and the tribes become better understood, it is hoped that the relationships of *Mastixiodendron* will become clearer. However, it can presently only be regarded as an anomalous member of the Cinchonoideae.

INTERSPECIFIC RELATIONSHIPS

Because the tribal affiliations of *Mastixiodendron* are uncertain, it is not possible to distinguish between ancestral and derived characters or to regard one species as "primitive" and others as "advanced." Nevertheless, interspecific relationships are discernible. Among the Fijian species, floral, fruit, and vegetative morphology is relatively diverse, although the oc-

currence of a few intermediate (hybrid?) collections indicates that *M. pilosum* and *M. robustum* are each probably closely related to *M. flavidum*. The restriction of semitectate pollen to the same three species (versus tectate-perforate pollen in others) further suggests that the Fijian taxa evolved from one ancestral population.

Among the extra-Fijian species, *Mastixiodendron smithii* and *M. plectocarpum* seem related on the basis of their pubescent discs and corolla exteriors, and their relatively cancellate and resinous fruits, while *M. pachyclados* and *M. stoddardii* share glabrous discs and relatively thin-walled fruits. Other characters are mentioned under the individual species.

TAXONOMY

Mastixiodendron Melch., Bot. Jahrb. **60**: 167. 1925; Danser, Blumea 1: 69. 1934; Merr. & Perry, Jour. Arnold Arb. **25**: 205. 1944; A. C. Sm., Jour. Arnold Arb. **26**: 108. 1945; Merr. & Perry, Jour. Arnold Arb. **26**: 254. 1945; A. C. Sm., Jour. Arnold Arb. **36**: 288. 1955, Pacif. Sci. **23**: 390. 1969.

Fagraeopsis Gilg & Schlechter in Gilg & Benedict, Bot. Jahrb. **54**: 197, *nom. provis.* 1916; Airy Shaw, Wills Dict. Fl. Pl. & Ferns. ed. 7. 443, *nomen nudum*, 1966, ed. 8. 453, *nomen nudum*, 1973.

Dorisia Gillespie, Hooker's Icon. Pl. **32**: *t. 3190.* 1933.

Trees or rarely shrubs, glabrous to pilose with spreading, septate hairs; branchlets compressed when young, at length subterete, ringed by prominent stipule scars; stipules caducous, prominent in terminal buds, strongly imbricate, often dextrorsely contorted, coriaceous to membranaceous at margin, glabrous or occasionally minutely puberulent with scattered hairs; petioles stout to relatively slender; leaf blades coriaceous to chartaceous, ovate to elliptic to broadly obovate, rounded to bluntly cuspidate or acuminate at apex, decurrent on petiole at base, entire at margin, the secondary nerves spreading from costa and anastomosing submarginally; inflorescences variously puberulent, thyrsoid with opposite branches terminating in 3-flowered dichasia, axillary to ultimate or penultimate leaves, the peduncles stout to slender, the inflorescence branches subtended by membranaceous bracts; calyx lobes 4 (very rarely 5), shortly united at base, entire at margin, glabrous outside; corolla lobes 4, fleshy, valvate in bud, free to base, entire at margin, essentially glabrous to finely but densely puberulent outside, papillate to pilose inside; stamens 4, alternate with corolla lobes, the filaments filiform to narrowly subulate, the anthers 2-locular, oblong-ovoid, subbasifixed; ovary 2-locular, somewhat less than half to almost completely inferior, the inferior portion turbinate to subglobose, the superior portion (disc) broad and flat to sharply raised and subconical; ovules solitary and subpendulous in each ovary locule; style often caducous, subcylindrical, glabrous, often shortly divided at apex; fruits drupaceous, woody to fibrous, frequently 1-locular by abortion, crowned or variously ringed by perianth scar; seeds long-ellipsoid, attached

over most of length to dissepiment, the testa variously rugose, the endosperm present.

TYPE SPECIES. *Mastixiodendron pachyclados* (K. Schum.) Melch.

KEY TO THE SPECIES AND VARIETIES OF MASTIXIODENDRON

1. Branchlets commonly more than 6 mm. broad toward apex; leaf blades usually rounded or broadly obtuse or occasionally bluntly cuspidate at apex; inflorescences relatively robust, with 3 to 4 (to 5) orders of branching; fruits subcylindrical to ellipsoid, rarely subglobose or turbinate, ringed by perianth scar 8–15 mm. below apex; Moluccas, New Guinea, and Bismarck Archipelago.
 2. Leaf blades entirely glabrous beneath. 1a. *M. pachyclados* var. *pachyclados.*
 2. Leaf blades pilose to puberulent beneath with scattered, spreading hairs. 1b. *M. pachyclados* var. *tomentosum.*
1. Branchlets commonly less than 6 mm. broad toward apex; leaf blades acuminate to obtuse and bluntly cuspidate at apex, not rounded; inflorescences with up to 3 orders of branching; fruits not as described above.
 3. Corolla lobes densely puberulent outside; disc subconical, finely but densely puberulent to papillate with minute, gray to stramineous hairs; mature fruits more than 45 × 20 mm., ringed by perianth scar less than 10 mm. from usually pointed apex; New Guinea. 2. *M. smithii.*
 3. Corolla lobes glabrous to almost imperceptibly puberulent outside with scattered hairs; disc not as described above; mature fruits either less than 45 mm. long, or with perianth scar more than 10 mm. below apex.
 4. Corolla limb about 10 mm. across; stamens with filaments frequently more than 2.5 mm. long; fruits long-tapering distally, ringed by perianth scar 15–25 mm. below apex; New Britain and Solomon Islands. 3. *M. stoddardii.*
 4. Corolla limb less than 10 mm. across; stamens with filaments up to 2.5 mm. long; fruits not as described above.
 5. Disc broad, flat, densely puberulent toward center, glabrous toward margin; fruits to 30 mm. long, ovoid to obovoid, broadly rounded at apex, the endocarp strongly cancellate and filled with clear to reddish resin; New Guinea. 4. *M. plectocarpum.*
 5. Disc rounded or subconical, glabrous; fruits not as described above; Fiji.
 6. Peduncles 3–4 mm. in diameter; calyx lobes more than 1.5 mm. broad at base; corolla lobes usually more than 2 mm. broad; fruits more than 15 mm. broad, the perianth scar 15–20 mm. below blunt to rounded apex. 5. *M. robustum.*
 6. Peduncles less than 3 mm. in diameter; calyx lobes less than 1.5 mm. broad at base; corolla lobes to 2 mm. broad; fruits less than 15 mm. broad, the perianth scar less than 10 mm. from acute apex.
 7. Leaf blades glabrous beneath, rarely puberulent; flower buds nearly as broad as long; corolla lobes less than 3 mm. long; disc broadly rounded, less than 0.5 mm. high; style less than 1 mm. long. 6. *M. flavidum.*
 7. Leaf blades pilose to tomentulose beneath; flower buds

more than twice as long as broad; corolla lobes 4–4.5 mm. long; disc subconical, about 1.5 mm. high; style 1.5–2 mm. long. 7. *M. pilosum*.

1. Mastixiodendron pachyclados (K. Schum.) Melch., Bot. Jahrb. 60: 168. *t. 1.* 1925.

Tree to 55 m. high, the bole straight, to 31 m. high, to 2 m. d.b.h., the buttresses straight, to 4 m. high, the crown compact to spreading with stout branches; bark variable from dark to pale gray or brown, pustular to fibrous and flaking, the inner bark and wood white to pale brown, darkening on exposure; branchlets robust, 6–10 mm. broad toward apex, dark red-brown to pale gray or brown; mature stipules lanceolate, 20–40 mm. long, 8–12 mm. broad, acuminate at apex; petioles stout, semiterete, (5–)10–30 mm. long, 3–6(–18) mm. broad, winged by base of leaf blade; leaf blades coriaceous, broadly obovate to elliptic, occasionally nearly spathulate, (11–)13–45 cm. long, (6–)8–24 cm. broad, rounded to very bluntly obtuse or occasionally bluntly cuspidate at apex, often strongly revolute at margin, glabrous and glossy above, glabrous or pilose to puberulent beneath with scattered hairs to 0.5 mm. long, the costa plane to canaliculate above, strongly raised and rounded beneath, the secondary nerves 7 to 12 per side, prominulous above, raised and rounded beneath, the tertiary nerves and veinlets prominulous to plane above and beneath; inflorescences puberulent with minute, scattered hairs to 0.1 mm. long, open to congested, with 3 to 4(to 5) orders of branching and 200 to 1000 (rarely more) flowers, 10–22 × 9–24 cm. at anthesis, 12–25 × 12–24 cm. in fruit, about as broad as long, the peduncles subterete, 1–5(–10) cm. long, 3–6 mm. in diameter, the inflorescence bracts deltoid to ovate, to 5 mm. long, 0.5–2.5 mm. broad at base, acute at apex; pedicels relatively stout, 1–1.5(–3) mm. long; calyx limb subpatelliform, spreading, 2.5–3(–4) mm. across, the lobes very broadly deltoid, 0.3–0.6(–0.8) mm. long, 1.5–2 mm. broad at base and united into a shallow cup, rounded to obtuse and minutely apiculate at apex, glabrous to puberulent outside with a few scattered hairs; corolla limb 6–8(–10) mm. across, the lobes yellow-green to greenish white, subdeltoid to broadly ovate, 2.5–3.5 mm. long, (1.5–)2–3(–3.5) mm. broad, glabrous to finely puberulent outside with scattered, minute, stramineous hairs, pilose distally inside with stiff, yellow hairs to 0.8 mm. long, glabrous toward base; filaments of stamens 1.5–3 mm. long, to 0.5 mm. broad at base, tapering toward apex, the anthers 0.8–1 × 0.5 mm.; inferior portion of ovary to 1 mm. long, 1.5–2.5 mm. in diameter, the disc broad and flat to rounded, about 0.5 mm. high, glabrous; style 1–1.5 mm. long, about 0.2 mm. in diameter, truncate to divided to 0.5 mm. at apex; fruits hard, yellow to green, drying pale gray or brown to black, glabrous, usually subcylindrical to ellipsoid, occasionally subglobose to broadly ovoid, rounded or bluntly pointed at both ends, (15–)22–35 × 8–15 mm., ringed by perianth scar 5–13 mm. below apex, the mesocarp dense, 0.5–1(–4) mm. thick, the endocarp to 3 mm. thick, bony; seeds 12–20 × 4–5 mm., pale yellow-brown, often folded lengthwise when dry.

Having examined nearly all of the available collections of *Mastixiodendron pachyclados*, I have distinguished two varieties based on the indument characters outlined in the preceding key. The vast majority of the collections are referable to the typical variety in which the leaf blades have glabrous lower surfaces. Specimens with pubescent leaf blades constitute *M. pachyclados* var. *tomentosum*.

1a. Mastixiodendron pachyclados (K. Schum.) Melch. var. pachyclados.

FIGURES 6; 10, a–h.

Fagraea pachyclados K. Schum. in K. Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzgeb. Südsee, 349. 1905; Gilg & Benedict, Bot. Jahrb. **54:** 196. 1916.
Mastixiodendron pachyclados Melch., Bot. Jahrb. **60:** 168. *t. 1.* 1925; C. T. White, Jour. Arnold Arb. **10:** 257. 1929; Lauterb., Bot. Jahrb. **63:** 467. 1930; Danser, Blumea **1:** 69. 1934; Merr. & Perry, Jour. Arnold Arb. **23:** 416. 1942.

NOMENCLATURE. Schumann based his description of *Fagraea pachyclados* on a single collection, *Rodatz & Klink 213*, gathered July 4, 1899. The locality given by Schumann is "Kaiser-Wilhelmsland: Bismarck-Gebirge." The holotype is mentioned by Melchior (cited above) as deposited in the Berlin herbarium, and therefore may be presumed destroyed. I have not seen any representatives of the type collection, although from Schumann's protologue there is no question concerning the identity of the taxon which the holotype represented. I therefore designate Schumann's description the lectotype.

A minor nomenclatural matter concerns the gender of the name *Mastixiodendron*. Recommendation 75A of the Code states that Greek generic names ending with "*-dendron*" should be considered neuter, regardless of the gender assigned to them by publishing authors. Consequently, some recent authors have altered the epithet of the type species of *Mastixiodendron* from *pachyclados* (masculine) to *pachycladon* (neuter) in order that it agree grammatically with the generic name. However, such agreement between the name of a genus and an epithet is required only if the epithet is adjectival. Schumann originally employed the epithet *pachyclados* in combination with the feminine generic name *Fagraea*; Melchior used the same epithet with *Mastixiodendron*. Such usage suggests that *pachyclados* ought to be regarded as an appositive noun not necessarily agreeing with the generic name. I have consequently maintained *M. pachyclados* as the name of the type species.

DISTRIBUTION AND ECOLOGY. The typical variety of *Mastixiodendron pachyclados* extends from the northern Moluccas eastward through New Guinea and the Bismarck Archipelago, and in altitude from near sea level to about 1100 meters. Populations frequently occur as pure or nearly pure stands in primary or secondary forests, on level or mountainous terrain, and often on clayey or sandy soils. Flowering and fruiting specimens have been gathered throughout the year.

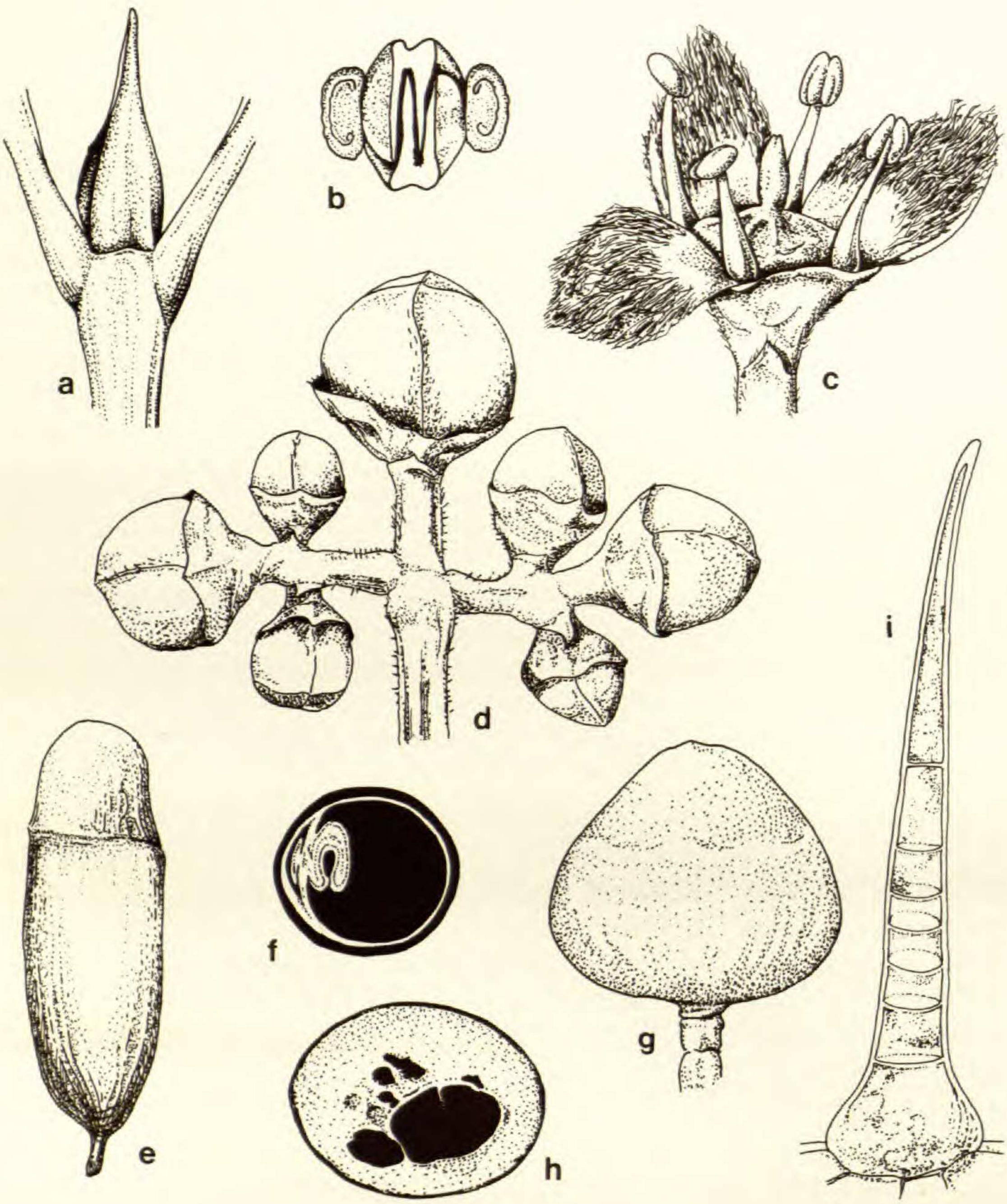


FIGURE 10. a–h, *Mastixiodendron pachyclados* var. *pachyclados*: a, stipule pair in terminal bud, × 1 (from *BW 8130 (Noesi)*); b, terminal bud in cross section showing imbricate stipules flanked by leaf bases, × 2 (from *Hoogland 4925*); c, flower with one corolla lobe removed, × 8 (from *Katik W2880*); d, terminal portion of inflorescence branch showing young and late flower buds, × 8 (from *Katik W2895*); e, fruit, × 2 (from *Hoogland 4925*); f, fruit in cross section showing developed and aborted seeds, × 2 (from *Brass 14097*); g, subglobose fruit, × 2 (from *NGF 36017 (Kumul)*); h, same in cross section, × 2. i, *Mastixiodendron pachyclados* var. *tomentosum*: trichome from abaxial surface of leaf blade showing relatively thick outer wall and thinner partitions, × 2500 (from *BW 1557 (Schram)*).

LOCAL NAMES. "Modjiu," "raimagogo" (Moluccas), "teitakka" (Manikiong), "ngoewaai" (Hattam), "siëk" (Noemfoor), "kriweek" (Biak), "koerdop" (Samber-Japen), "not-notie" (Kwesten), "klaoedi" (Kentoek), "kraoedu" (Kemtoek), "ambehend" (Tami), "loe," "maneu" (Iko), "woent" (Waris), "igo" (Nemo), "wamami" (Timbunke), "monnampun" (Kaigorin), "monnanden" (Rawa), "garo garo" (Dawa Dawa), "aimo" (New Britain).

Moluccas.[1,2] MOROTAI: Tobelo, north Totodokoe, *bb 33742* (*Tangkilisan 31*) (A, BRI, L, LAE); Totodokoe, *bb 33768* (*Tangkilisan 72*) (A, BRI, L, LAE); Tilai River, *bb 33890* (*Tangkilisan 2171*) (L); Sangowo, *Kostermans 1044* (A, L); Sangowo River, *Kostermans 1408* (A, L, NY). TERNATE: Bantjan, *bb 16464* (L). HALMAHERA: Weda, Tiloppe, *bb 24870* (A, L), *bb 24896* (L). CERAM: Kiandarat, *bb 25860* (L); Rioeapa River, *Rutten 1604* (L). **West New Guinea.** VOGELKOP: Manaswari Island, Mansinam, *Herb. Beccari 9984a* (L); Manokwari, Oransbari *BW 1555* (*Schram*) (A, CANB, K, L, LAE), *BW 4570* (*Lasschuit*) (CANB, L, LAE). GEELVINK BAY: Noemfoor Island, Biak, *BW 1019* (*Koster*) (L); Noemfoor Island, *NGF 312* (LAE); Japen Island, Soemberbaba, *BW 11141* (*Koster*) (A, BRI, CANB, K, L, LAE); Japen Island, Aisao, *BW 10558* (*Schram*) (L). DJAJAPURA: Takar, *BW 2279* (*Mangold*) (L, LAE); Sekoli, *BW 8130* (*Noesi*) (CANB, L, LAE); Sekoli-vlakte, *BW 9398* (*Schram*) (CANB, L, LAE); Sekoli, south of Lake Sentani, *BW 9462* (*Schram*) (CANB, L, LAE); Hollandia, *BW 4819* (*Versteegh*)* (CANB, L); Dozai, *Kostermans & Soegong 400* (A, L); Tami, Holtekang, *BW 824* (*Brouwer*) (A, CANB, L, LAE); mouth of Tami River, *BW 2677* (*Schram*) (CANB, L, LAE), *BW 2682* (*Schram*) (CANB, L, LAE); Tami, *BW 1640* (*Schram*) (CANB, L, LAE); Nemo, *BW 2791* (*Schram*) (L), *BW 3473* (*Kalkman*) (A, CANB, K, L, LAE); Idenburg River, Bernhard Camp, *Brass 14097* (A, BM, BRI, L, LAE), *Brass & Versteegh 13548* (A, BM, BRI, K, L). **Northeast New Guinea.** WEST SEPIK: vicinity of Vanimo, Yakara Hill, *NGF 36017* (*Kumul*)* (A, BRI, CANB, L, LAE); Aitape, *NGF 514* (*McAnalan*) (A, BRI, LAE), *NGF 523* (*McAnalan*) (A, BRI, LAE); southeast of Tadji Airstrip, *NGF 1200* (*L. S. Smith*) (A, BRI, CANB, K, L, LAE); Yellow River, near Sepik River, *NGF 3860* (*Womersley*) (L, LAE). EAST SEPIK: north of Timbunke, on track to Kwoiwut, *Pullen 1676** (A, CANB, L, LAE). MADANG: Josephstaal, *NGF 10305* (*K. J. White*) (LAE); Aiome, south side of Asai River, *NGF 27482* (*Henty*) (CANB, L, LAE); Gogol River, *NGF 46521* (*Katik*)* (BRI, L, LAE); Gogol Base, *Oswell W2668* (LAE), *Katik W2737* (L, LAE); south of Gogol River, vicinity of Mawan, *Hoogland 4925* (A, CANB, K, L, LAE); Aupan logging area, *Katik W2880* (A, BISH, CANB, L, LAE), *W2882* (A, BRI, CANB, L, LAE), *W2884* (L, LAE), *W2886* (L, LAE), *W2891* (LAE), *W2892* (LAE), *W2895* (BRI, CANB, K, L, LAE), *W2896* (L, LAE), *W2897* (BRI, L, LAE); Amiaba River, *NGF 45877* (*Foreman et al.*) (A, BISH, CANB, L, LAE). MOROBE: Bulolo felling area, *NGF 10145* (*K. J. White*) (LAE); Ganalangumbum, *NGF 26086* (*Streimann*) (LAE). **Papua.** GULF: Vailala River, above Lohiki, *Pullen 6451* (CANB, LAE); vicinity of Lohiki village, *Schodde 4278* (A, L, LAE); Ihu Hill, northwest of Ihu, *Schodde 4245* (A, CANB, L, LAE); Ihu, *Brass 943* (A); vicinity of Putei, junction of Tauri and Kapau Rivers, *Craven & Schodde 954* (CANB). CENTRAL: Trans Brown, *NGF 17392* (*Havel & Kairo*) (A, BRI, CANB, L, LAE, US);

[1] Abbreviations of institutional collecting series and the names of geographical subdivisions in New Guinea and the Bismarck Archipelago follow Coode, 1973.

[2] Collections of *M. pachyclados* var. *pachyclados* marked with an asterisk (*) have subglobose fruits.

Cape Rodney, *Dobson 1393* (K, LAE), *NGF 38581 (Henty)* (A, BISH, BRI, CANB, K, L, LAE). NORTHERN: vicinity of Siurane, south side of Hydrographers Range, *Pullen 5534* (CANB). MILNE BAY: river bank and flats about 1.6 km. up Dawa River, *NGF 1334 (L. S. Smith)* (A, L, LAE); Milne Bay, without further locality, *McAdam s.n.* (LAE). **Bismarck Archipelago.** NEW BRITAIN: vicinity of Urin, South New Britain, *NGF 10036 (K. J. White)* (A, L, LAE). NEW IRELAND: inland from Lavongai, *NGF 29673 (Coode & Cropley)** (A, BISH, BRI, CANB, L, LAE); New Hanover, Taskul, *Coode 3734* (LAE). MANUS: Kaguli Ridge, *LAE 59236 (Foreman & Katik)** (BISH, LAE).

1b. **Mastixiodendron pachyclados** var. **tomentosum** S. Darwin, var. nov.

FIGURE 10, i.

Arbor idem ac varietas typica sed foliorum laminis subtus in nervis et laminis pilis dispersis effusis stramineis vel fuscis ad 0.5 mm. longis pilosis vel puberulis differt.

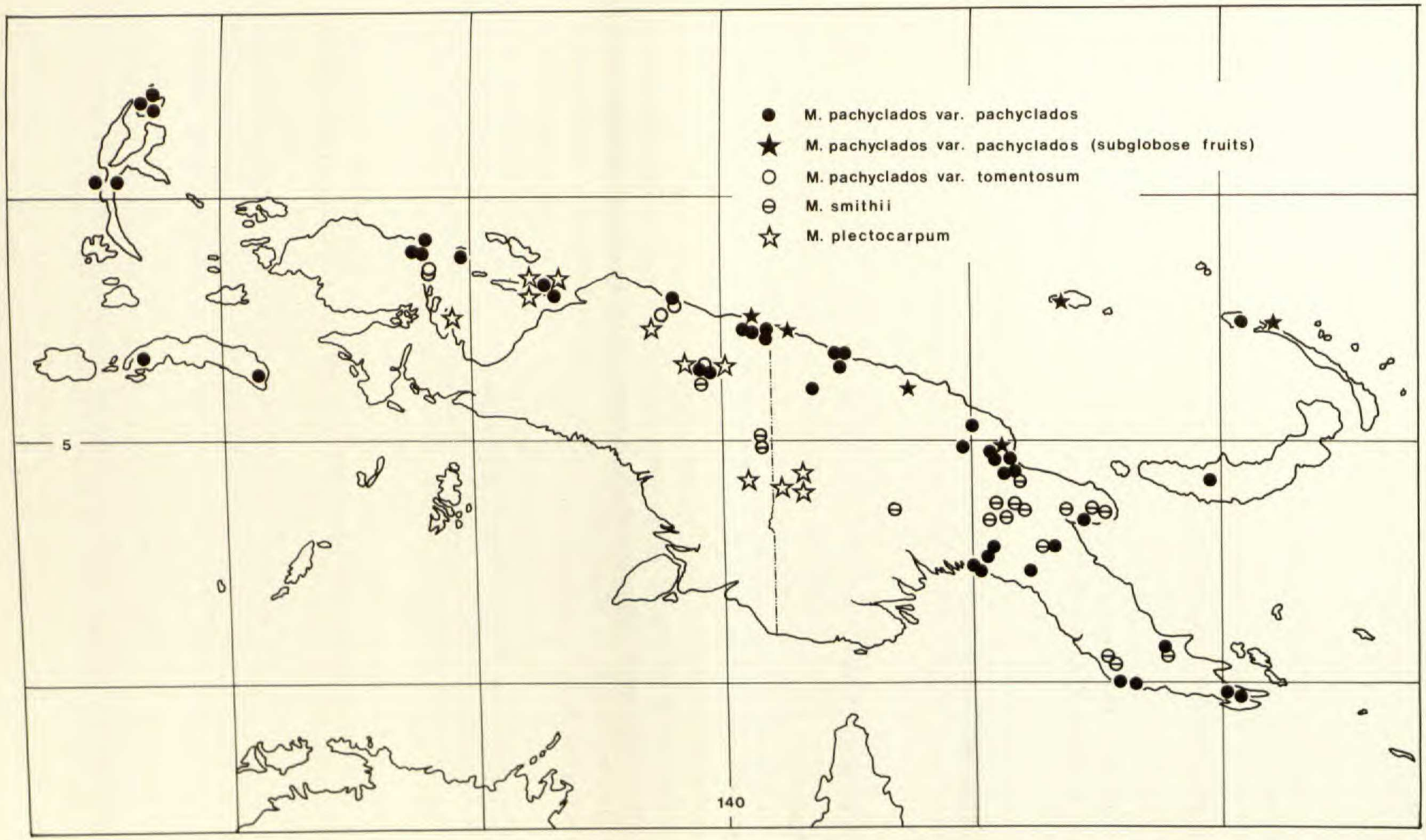
NOMENCLATURE. The type of this new variety is *BW 4569* (cited below) collected by J. A. Lasschuit on February 1, 1958, at Oransbari, Vogelkop, West New Guinea, in an area of primary forest, sandy soil, and at about 15 meters altitude. Specimens were gathered from a tree 40 meters high with a trunk about 98 cm. d.b.h. The flowers are noted as being green when alive. Mature fruits have not been seen.

DISTRIBUTION AND ECOLOGY. Thus far known only from West New Guinea, *Mastixiodendron pachyclados* var. *tomentosum* is frequently encountered on the east coast of the Vogelkop Peninsula. Other collections have been made in coastal areas of Djajapura and farther inland near the Idenburg River. This variety is commonly a tree of the primary forest, growing on rocky, sandy, clayey, or limestone soils and at altitudes from near sea level to about 50 meters. Flowering specimens have been gathered in February and November; a specimen with very young fruits, in October.

LOCAL NAMES. "Teitakka," "tladdjni" (Manikiong), "benggvewai" (Waean), "nggoeway" or "ng-goewaai" (Hattam), "bakwiet" (Kwesten), "elieuw" (Berik).

West New Guinea. VOGELKOP: vicinity of Andai, southwest of Manokwari, *BW 11825 (Koster)* (L, LAE); Oransbari, *BW 1128 (Koster)* (CANB, L, LAE), *BW 1557 (Schram)* (CANB, L, LAE), *BW 1929 (Schram)* (A, CANB, K, L, LAE), *BW 1949 (Schram)* (L), *BW 2125 (Mangold)* (CANB, L, LAE), *BW 2527 (Brouwer)* (L), *BW 4542 (Lasschuit)* (L), *BW 4569 (Lasschuit)* (CANB, holotype; isotypes at A, L, LAE), *BW 4571 (Lasschuit)* (L), *BW 4577 (Lasschuit)* (CANB, L, LAE), *BW 7301 (Hildebrand)* (LAE). DJAJAPURA: Takar, *BW 2270 (Mangold)* (CANB, L, LAE); near bivouac Oereb, *BW 9068 (Iwanggin)* (CANB, L, LAE); Bernhard-bivak, *bb 25675* (L).

Mastixiodendron pachyclados is by far the most frequently collected species of that genus in Papuasia (the only species which extends into the Moluccas), and is readily distinguished by its robust branchlets, leaves,



MAP 1. Collection sites of some species of *Mastixiodendron* in the Moluccas, New Guinea, and the Bismarck Archipelago.

and inflorescences. The leaves especially are distinct in their large size, frequently rounded apices, and stout petioles. Leaves with bluntly cuspidate apices are common in collections from the Moluccas (in which instances the leaves are also often very large), but cuspidate, obtuse, and rounded apices may occur in single specimens from New Guinea. In a few collections (*e.g.*, *NGF 17392* (*Havel & Kairo*) and *NGF 1334* (*L. S. Smith*), from southeastern Papua) the leaves may be consistently obtuse and closely resemble those of *M. smithii*, although the branchlets have a robustness more characteristic of the present species.

The inflorescences of *Mastixiodendron pachyclados* usually have stout peduncles and pedicels and are about as broad as long, frequently with more than 500 flowers. Inflorescences of other species are usually not so large and are longer than broad. The flowers of the present species are recognized by their comparatively short and spreading calyx limbs, by the particularly fleshy corolla lobes, and by the flower buds which are four-angled and about as broad as long. Flowers and flower buds of similar proportion are found in *M. robustum*, from Fiji, but that species differs strongly in its smaller, fewer-flowered inflorescences and smaller leaves, among other characters. The flowers of *M. smithii* differ in their corolla lobes, which are densely puberulent outside, and in the disc, which is subconical and puberulent.

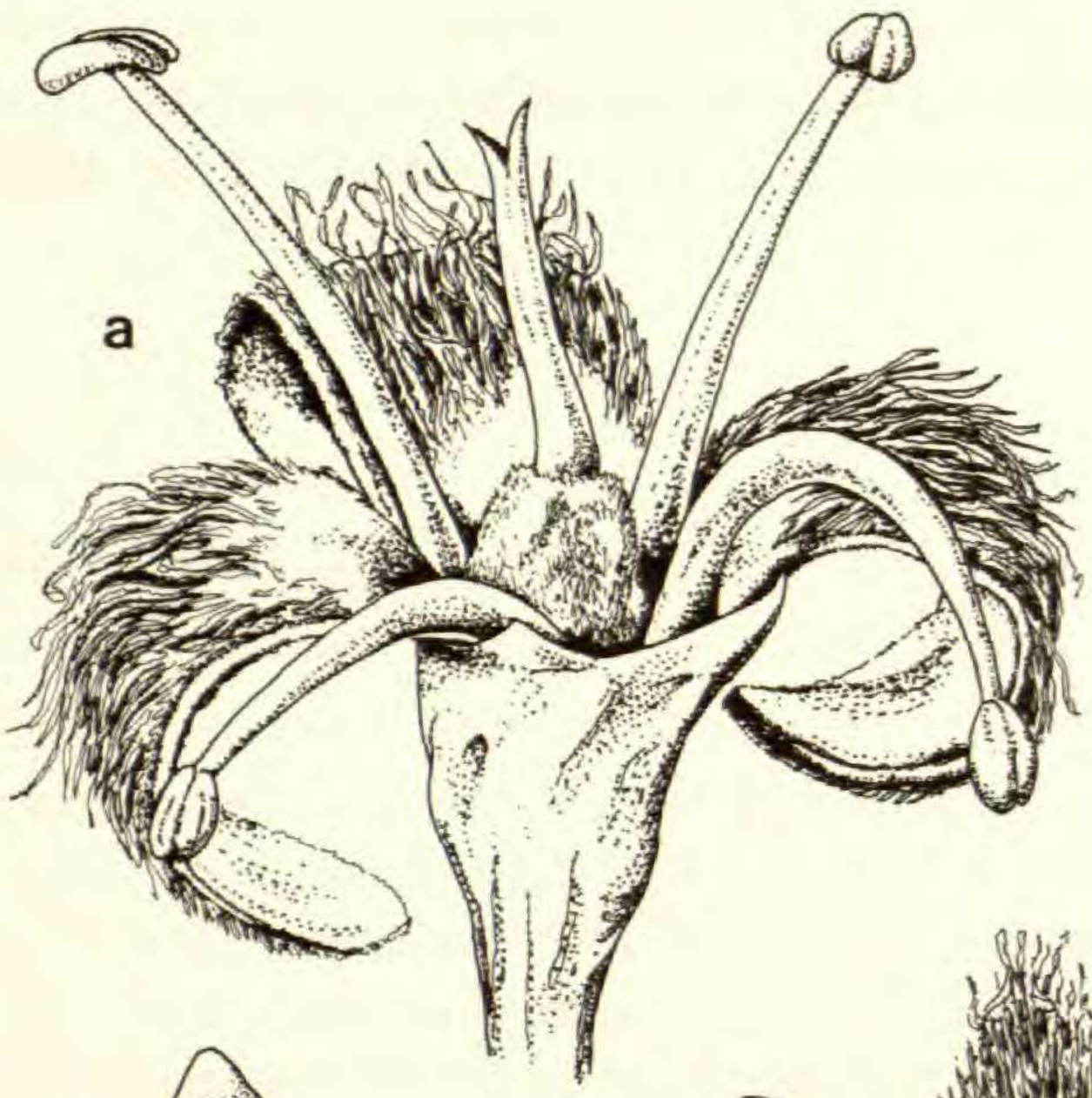
The fruits of *Mastixiodendron pachyclados* are usually long-ellipsoid or subcylindrical. They are aromatic, but lack strongly cancellate tissue. As indicated by the position of the perianth scar, the ovary is seldom more than half superior. The fruits are nearly globose when young but gradually elongate, although in a few collections the fruits remain subglobose or turbinate at maturity; in at least one collection (*Coode 3734*, from New Hanover), the fruits are somewhat intermediate between globose and cylindrical, and have relatively thick walls. The occurrence of subglobose fruits is occasionally associated with relatively large flowers (e.g., *NGF 29673* (*Coode & Cropley*)), but is not reliably correlated with any other floral or vegetative characters. In addition, the subglobose fruits which I have examined are sterile, possibly as the result of insect damage. I therefore have not given collections with subglobose fruits any formal taxonomic recognition, even though they are geographically restricted to the Bismarck Archipelago and the north coast of New Guinea (MAP 1). Until such time as they can be studied in greater detail, I retain those collections within the typical variety of the present species.

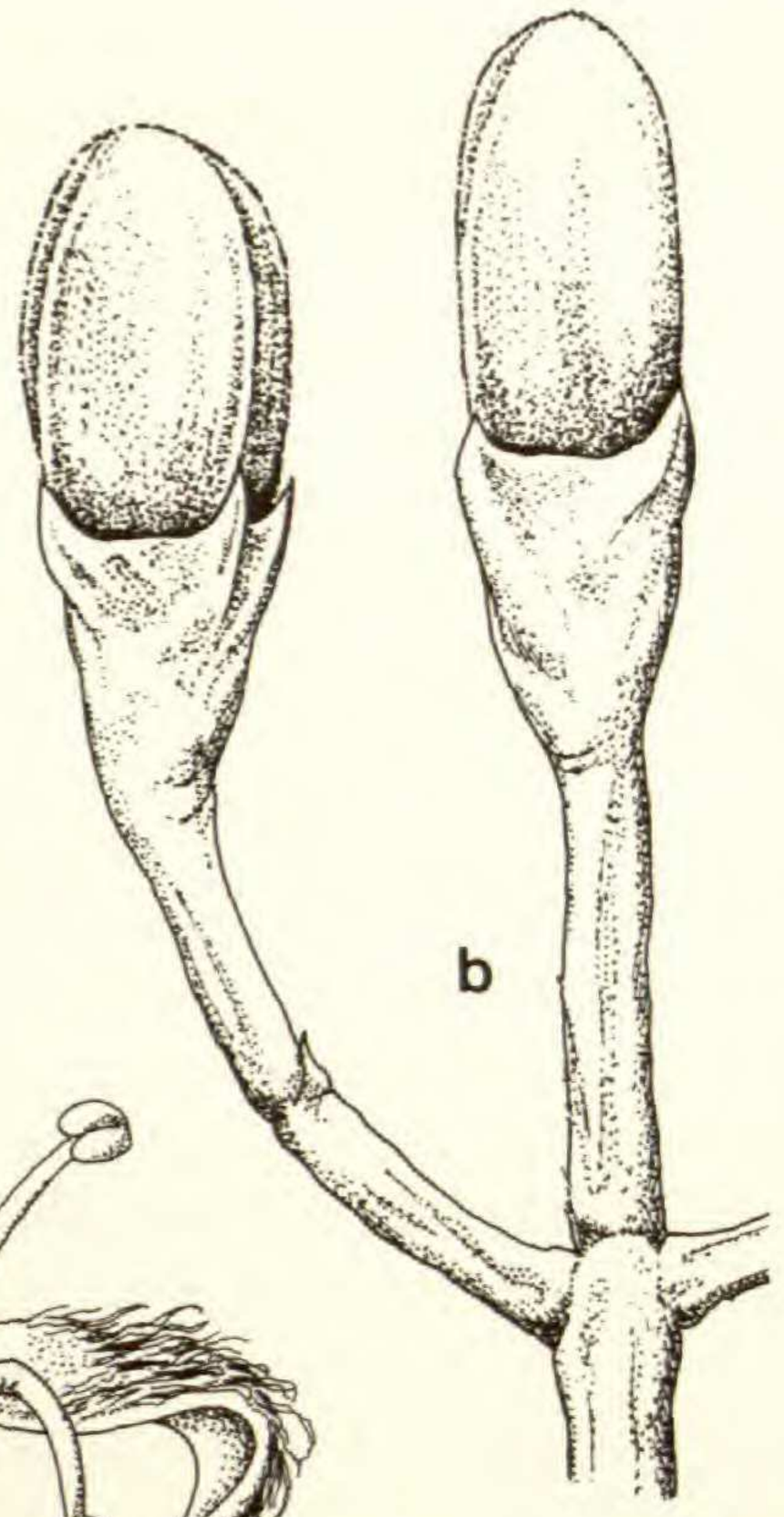
Specimens of *Mastixiodendron pachyclados* are usually glabrous except for the inflorescences, which are finely puberulent. However, in a few collections the lower surfaces of the leaf blades are puberulent to pilose. Similar variability in indumentum is evident among Fijian species of *Mastixiodendron*, but in those instances the presence or absence of indumentum on the leaf blades correlates well with numerous other features of the inflorescences, flowers, and fruits. Most available collections of *M. pachyclados* with pubescent leaf blades are sterile, but in the few cases where flowering inflorescences are present they are similar to those of

glabrous specimens. The pubescence on the leaf blades of a few collections might therefore be attributed to random variation were it not that such collections show a reasonably discrete geographical distribution (MAP 1). For that reason I recognize them as comprising a new variety, *M. pachyclados* var. *tomentosum*.

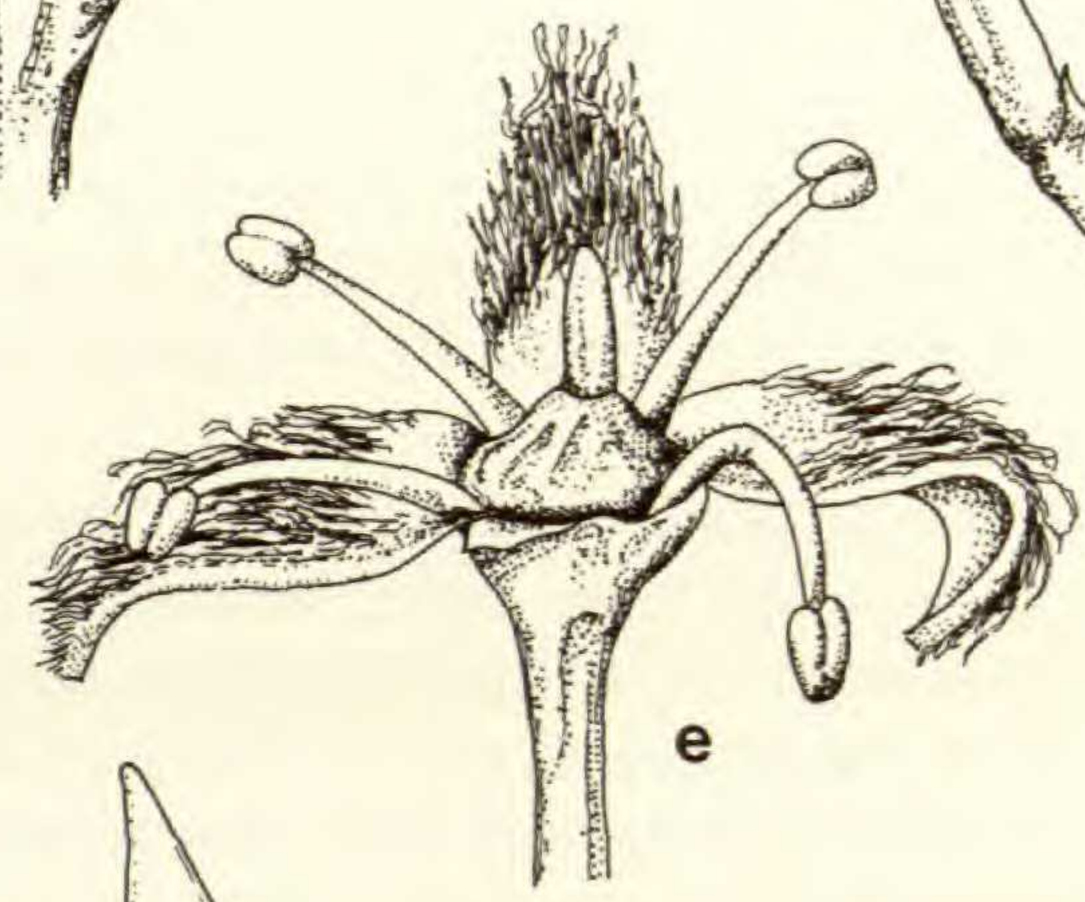
2. **Mastixiodendron smithii** Merr. & Perry, Jour. Arnold Arb. **26**: 255. 1945. FIGURES 1; 8; 11, a–d.

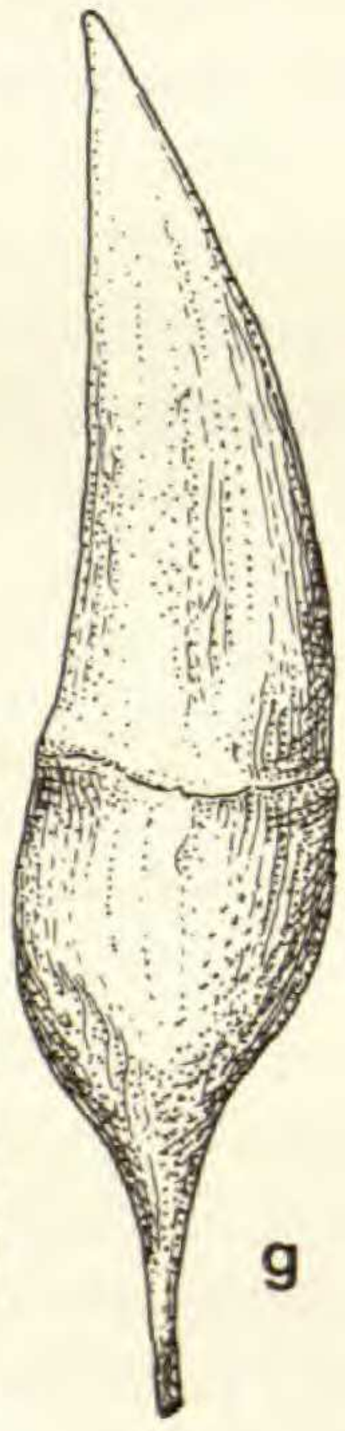
Tree to 45 m. high, the bole often twisted, to 27 m. high, to 3 m. d.b.h., the buttresses few, to 4 m. high, the crown narrow and compact; bark variable from pale green-brown to black, smooth to fissured, often pustular to flaking, the inner bark and wood white to pale yellow-brown, darkening on exposure; branchlets 3–5(–7) mm. broad toward apex, dark red-brown, becoming pale gray to brown; mature stipules lanceolate to oblong-lanceolate, 25–35 mm. long, 8–10 mm. broad, long acuminate at apex; petioles relatively stout, semiterete, 15–25(–35) mm. long, 2.5–4 mm. broad, winged by base of leaf blade; leaf blades coriaceous, elliptic to obovate, (8–)10–21 cm. long, (4–)5–10 cm. broad, acute to obtuse and bluntly cuspidate at apex, often somewhat revolute at margin, glabrous and glossy above, glabrous and often paler beneath, the costa conspicuous, plane to prominulous above, raised and rounded beneath, the secondary nerves 9 to 13 per side, prominulous above, more prominent beneath, the tertiary nerves and veinlets prominulous above and beneath; inflorescences finely puberulent with minute, scattered, stramineous hairs to 0.1 mm. long, relatively robust, open, with 2 to 3 orders of branching and as many as 450 flowers, 9–12 × 6–15 cm. at anthesis, considerably larger in fruit, the peduncles subterete, 1–5 cm. long, 2–4 mm. in diameter, the inflorescence bracts deltoid, to 1 mm. long, to 0.5 mm. broad at base, acute to acuminate at apex; pedicels slender, 3–4 mm. long; calyx limb cupular, 2–3 mm. across, the lobes coriaceous to membranaceous, deltoid to broadly ovate, 0.5–1(–1.5) mm. long, about 1 mm. broad, acute to nearly cuspidate at apex, united at base into shallow cup to 0.5 mm. high, glabrous to minutely puberulent outside with scattered hairs; corolla limb to 9 mm. across, the lobes green to white, lanceolate to ovate to oblong, 3.5–4.5 mm. long, 1.2–1.6 mm. broad, minutely but densely puberulent outside with gray to stramineous hairs, densely pilose over most of surface inside with lax, tangled, stramineous to yellow hairs to 1.2 mm. long, glabrous toward base; filaments of stamens 2.5–3.5 mm. long, about 0.3 mm. broad at base, tapering toward apex, the anthers 0.5–0.8 mm. long, about 0.5 mm. broad; inferior portion of ovary 1.5–2 × 1.5(–2.5) mm., the disc subconical, about 1 mm. high, to 1.5 mm. broad at base, blunt at apex, minutely but densely puberulent to papillate with gray to stramineous hairs less than 0.05 mm. long; style about 2 mm. long, about 0.2 mm. in diameter, truncate or divided about 0.2 mm. at apex; fruits hard, fibrous to woody, pale yellow-green to gray-green, glabrous, ovoid to broadly fusiform, often subquadrangular, 48–70 × 20–30 mm., ringed by perianth scar less than



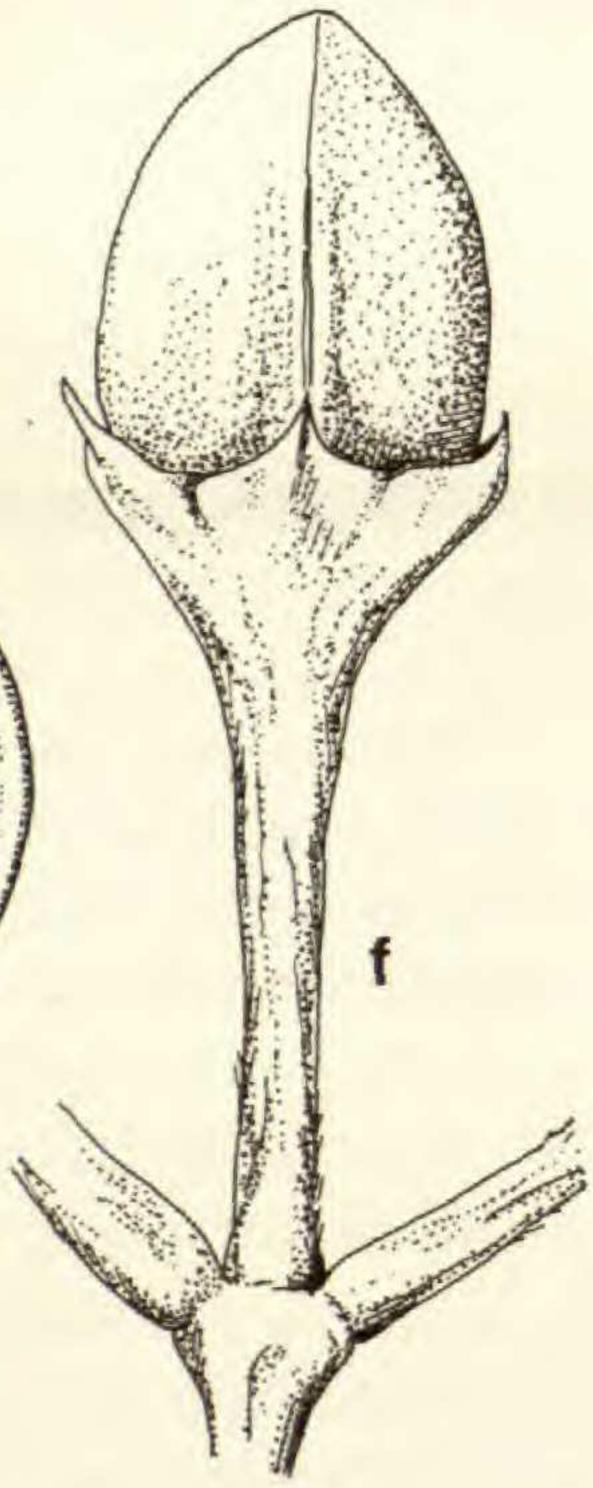












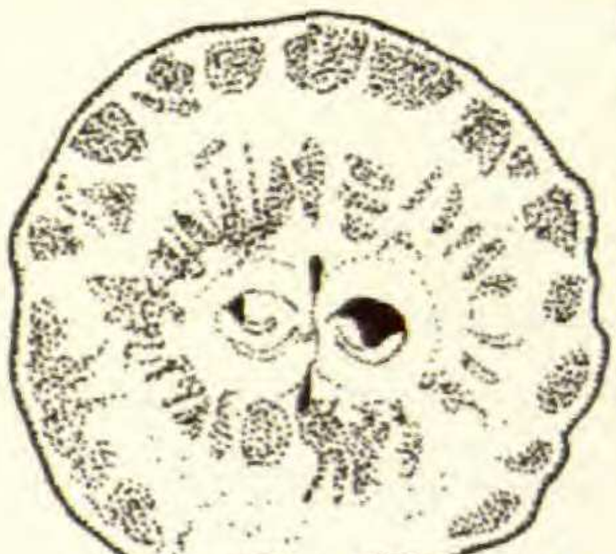


FIGURE 11. a–d, *Mastixiodendron smithii*: a, flower with one corolla lobe removed, × 10 (from *NGF 29193* (*Henty & Coode*)); b, terminal and one lateral branch of dichasium showing flower buds, × 8 (from *NGF 29193* (*Henty & Coode*)); c, fruit, × 1 (from *NGF 1022* (*L. S. Smith*)); d, fruit in cross section showing two locules and areas of cancellate tissue, × 1 (from *Carr 14789*). e–h, *Mastixiodendron stoddardii*: e, flower with one corolla lobe removed, × 5

10 mm. below usually pointed apex, the mesocarp fleshy, to 1 mm. thick, the endocarp cancellate with cavities filled with yellow to reddish resin; seeds to 22 × 4 mm., yellow-brown, often folded lengthwise when dry.

NOMENCLATURE. The type of *Mastixiodendron smithii* is *Clemens 5154,* cited below. The locality given on the holotype is "Ogeramnang" (Ogeranang in eastern Morobe district). The type collection, in late flowering condition, was gathered at an altitude of about 1800 meters from a tall tree growing on a forested hillside. The flowers were whitish green. An herbarium stamp suggests that an isotype may have been deposited at Berlin.

DISTRIBUTION AND ECOLOGY. The present species is endemic to New Guinea, occurring principally in the eastern portions of Northeast New Guinea and Papua, but with populations extending into central West New Guinea. Isolated individuals of *Mastixiodendron smithii* have been collected at altitudes from 800 to 1900 meters in primary or secondary forests. Flowering and fruiting specimens have been gathered throughout the year.

LOCAL NAMES. "Umani" (Eastern Highlands), "nowaki" (Aiyura), "pein" (Akuna), "china" (Anona), "tsekigi" (Kutubu), "naháterеh" (N. Managalase).

West New Guinea. DJAJAPURA: Idenburg River, 6 km. southwest of Bernhard Camp, *Brass & Versteegh 12517* (A, L). SNOW MOUNTAINS: headwaters of Ok Denim River, *NGF 33079 (Henty et al.)* (A, CANB, K, L, LAE), *NGF 33211 (Henty et al.)* (A, BRI, CANB, L, LAE). **Northeast New Guinea.** MADANG: Budemu, *NGF 21328 (Sayers)* (A, BM, L). MOROBE: Araulu logging area, *LAE 62089 (Katik & Eddowes)* (BISH, LAE, US); Boana, *Clemens 5154* (A, holotype; L, isotype); Yunzaing, *Clemens 3723* (A, L). EASTERN HIGHLANDS: Kassam Pass, *NGF 29193 (Henty & Coode)* (A, CANB, L, LAE), *NGF 29351 (Henty & Vandenberg)* (A, CANB, L, LAE); Aiyura, *NGF 1022 (L. S. Smith)* (A, BRI, LAE), *NGF 3381 (Womersley)* (A, CANB, K, L, LAE); vicinity of Okapa, *Hornibrook 182A* (LAE); vicinity of Perosa, about 29 km. southwest of Okapa, *Hartley 13182* (A, CANB, L, LAE). **Papua.** SOUTHERN HIGHLANDS: vicinity of Moro, Lake Kutubu, *Schodde 2402* (CANB, L, LAE). CENTRAL: Boridi, *Carr 13272* (BM, L), *14788* (BM, L), *14789* (A), LAE *60289 (Foreman & Vinas)* (A, BISH, LAE). NORTHERN: south side of Hydrographers Range, vicinity of Siurane, *Pullen 5472* (CANB, L, LAE).

Mastixiodendron smithii is a very distinct species, easily recognized by its more or less oblong flower buds and minute but dense puberulence on the outside of the corolla lobes. As the fruit matures and the corolla falls away, a similar indumentum becomes obvious on the subconical disc. The fruits are also remarkable for their comparatively large size, the perianth scar, which is located near the usually sharply pointed apex, and the woody to fibrous interior with resin cavities.

(from *BSIP 10145 (Sirute'e et al.)*); f, terminal flower of dichasium in bud, × 8 (from *BSIP 10159 (Gafui et al.)*); g, fruit, × 2 (from *BSIP 9118 (Gafui et al.)*); h, same in cross section showing developed and aborted seeds, × 3.

In all of the above features, the present species is distinct from *Mastixiodendron pachyclados*, which also differs in its larger inflorescences, often rounded leaf apices, and stouter branchlets, among other characters. Merrill and Perry (cited above) compared *M. smithii* with *M. stoddardii*, which is similar in the shape and size of its leaves. However, in the latter species the corolla lobe exteriors and the more rounded discs are glabrous, and the flower buds are ovoid rather than oblong. The fruits of *M. stoddardii* are frequently more than half superior and are comparatively thin-walled.

The closest ally of *Mastixiodendron smithii* is probably *M. plectocarpum*. In both taxa the flower buds and the expanded corolla lobes are similarly shaped, and the corolla lobe exteriors in the latter species may be somewhat puberulent; the disc in *M. plectocarpum* is likewise puberulent, although it is flat rather than subconical. As to fruits, there can be little confusion between those of the present species and those of *M. plectocarpum*, which, although strongly cancellate, are much smaller and rounded at the apex. The two species further differ in vegetative characters, *M. plectocarpum* generally having more delicate branchlets, petioles, and inflorescences, as well as smaller and usually narrower leaf blades with finer venation. In one collection (*Brass & Versteegh 12517*, from West New Guinea), I have found fruits of the *M. plectocarpum* type associated with vegetative parts and young flower buds clearly referable to *M. smithii*. However, because the fruits are not attached, and since the collectors gathered specimens of both species at the same locality, it is possible that the collection represents an unintentional admixture and not a morphologically "intermediate" entity.

3. **Mastixiodendron stoddardii** Merr. & Perry, Jour. Arnold Arb. **26**: 254. 1945; Whitmore, Guide Forests Brit. Solomon Isl. 95. 1966.

FIGURES 4; 11, e–h.

Mastixiodendron Smithii sensu Walker, Forests Brit. Solomon Isl. Prot. 162. 1948; non Merr. & Perry.

Tree to 30 m. high, the bole often poorly formed, about 1 m. d.b.h., the buttresses thick, to 3 m. high, the crown small, dense, with heavy, ascending limbs; bark pale to dark gray or brown, narrowly fissured, papery and flaking, the inner bark and wood white to pale yellow-brown, darkening on exposure, and with the odor of linseed oil; branchlets 2–4 mm. broad toward apex, dark red-brown, becoming pale gray-brown; mature stipules elliptic to lanceolate, 13–22 mm. long, to 8 mm. broad, acuminate at apex; petioles relatively slender, semiterete to somewhat canaliculate, 10–25(–30) mm. long, to 2.5 mm. broad, winged by base of leaf blade; leaf blades coriaceous to chartaceous, elliptic to occasionally obovate, 7–23 cm. long, 3–11 cm. broad, acute or acuminate or bluntly cuspidate at apex, glabrous, often drying paler beneath, the costa conspicuous, plane to somewhat canaliculate above, raised and rounded beneath, the secondary nerves 10 to 16 per side, prominulous above, raised and rounded

to prominulous beneath, the tertiary nerves and veinlets prominulous to plane above and beneath; inflorescences finely puberulent with scattered, minute hairs, relatively delicate, open, often more or less flat-topped, usually with 2 orders of branching and 15 to 40 flowers, 7–8.5(–12) × 3.5–7(–9) cm. at anthesis, 11–15 × 5–16 cm. in fruit, the peduncles slender, (1–)3.5–6.5(–10) cm. long, 1–1.5 mm. in diameter, the inflorescence bracts subdeltoid, to 1 mm. long, to 1 mm. broad at base, acuminate at apex; pedicels slender, (3–)4–5 mm. long; calyx limb cupular, to 4.5 mm. across, the lobes coriaceous to membranaceous, deltoid, 0.5–1 mm. long, 1–2 mm. broad, acuminate to obtuse and apiculate at apex, united at base into shallow cup to 0.5 mm. high, glabrous outside; corolla limb about 10 mm. across, the lobes pale yellow-green, deltoid to ovate, 3–4 mm. long, 1.5–2.5 mm. broad, essentially glabrous outside, densely pilose distally inside with lax, tangled, yellow hairs to 1.5 mm. long, glabrous toward base; filaments of stamens 2.5–3 mm. long, about 0.3 mm. broad at base, tapering toward apex, the anthers 0.8–1 mm. long, about 0.5 mm. broad; inferior portion of ovary to 1 mm. long, about 2 mm. broad, the disc broadly ovoid, 1.5–2 mm. high, 2–2.5 mm. broad at base, glabrous; style 1–1.5 mm. long, about 0.3 mm. in diameter, truncate to rounded at apex; fruits hard, pale green when alive, drying pale brown to black, glabrous, ovoid or rarely oblong, gradually tapering toward apex, 25–45 mm. long, 8–13 mm. broad, ringed by perianth scar 15–25 mm. below apex, the mesocarp thin and dense, the endocarp hard, bony, 0.5–2 mm. thick; seeds about 24 × 5 mm., yellow- to red-brown.

NOMENCLATURE. The type collection named by Merrill and Perry is *Stoddard 12*. The holotype is a flowering specimen from "Banika Island in Russell Islands," without further locality.

DISTRIBUTION AND ECOLOGY. *Mastixiodendron stoddardii* is known from Guadalcanal, from surrounding islands of the Solomon Islands, and from New Britain in the Bismarck Archipelago. The species occurs in well-drained, forested areas at altitudes of 60 to 350 meters. Flowering and fruiting specimens have been collected throughout the year.

LOCAL NAMES AND USE. The following names, all from the Solomon Islands, have been noted: "kakarafua" or "kakarahua" (Kwara'ae), "aitalinge" or "aisalinga" (Longu), "haipatchou" (Guadalcanal), and "mumu" (Malaita). The present species is said to have a hard, durable wood suitable for construction, although the ill-formed bole would preclude its use in commerce.

Bismarck Archipelago. NEW BRITAIN: west branch of Fullerborn Harbor, *NGF 21741 (Sayers)* (A, CANB, L, LAE); Powell Harbor, *LAE 52106 (Foreman)* (K, LAE). **Solomon Islands.** RUSSELL ISLANDS: Mbanika Island, *Stoddard 12* (A, holotype). GUADALCANAL: Wanderer Bay, ridge west of Mbilikovu River, *BSIP 9110 (Gafui et al.)* (L), *BSIP 9118 (Gafui et al.)* (K, L, LAE); west coast behind Nduindui Village, *BSIP 10145 (Sirute'e et al.)* (K, L, LAE); south coast, Kolotsiri Ridge near Nduindui, *BSIP 10159 (Gafui et al.)* (K, L, LAE); Rere River,

about 4.8 km. inland, *BSIP 2791 (Whitmore)* (K, L, LAE), *BSIP 3804 (Whitmore)* (L, LAE); ridge west of Valasi River, *BSIP 326 (Leggate)* (L, LAE); Kaukau Bay, Singgalia River, *BSIP 250 (F. S. Walker)* (A, BRI, K, L). SAN CRISTOBAL: Wairaha River, 8 km. from coast, *BSIP 4228 (Whitmore)* (L, LAE).

In addition to the type collection from the Solomon Islands, Merrill and Perry (cited above) assigned a few fruiting collections from West New Guinea to *Mastixiodendron stoddardii*, although they pointed out differences in vegetative characters between collections from those two localities. Since that first description, more abundant material from the Solomon Islands has shown that the fruits associated with *M. stoddardii*, sensu typi, are not at all like those of New Guinea collections, which are here referred to *M. plectocarpum*.

The fruits of *Mastixiodendron stoddardii* are more or less half superior, relatively thin-walled, and lack a strongly cancellate tissue; in all such respects they resemble the fruits of *M. pachyclados*. However, the fruits of the present species are usually ovoid, rather than ellipsoid or subcylindrical, and are long-tapering toward the apex. A relationship between *M. stoddardii* and *M. pachyclados* is suggested by collections from New Britain (*NGF 21741 (Sayers)* and *LAE 52106 (Foreman)*), which resemble the former species in their vegetative features, but approach *M. pachyclados* in the shape and size of their fruits.

The similarity of *Mastixiodendron stoddardii* to *M. pachyclados* hardly goes further than the structure of the fruits. The broad corolla limb, elongate corolla lobes, open inflorescences, long and slender pedicels, and the leaf blades with acute to acuminate apices all suggest *M. smithii*. However, although the present species shows affinities with both of the above-mentioned taxa, it is nonetheless unique in many of its characters and is reasonably well isolated geographically.

4. Mastixiodendron plectocarpum S. Darwin, sp. nov.

FIGURES 7, 9, 12.

Arbor ad 35 m. alta, trunco ad 25 m. alto ad 60 cm. diametro, anteridibus nullis vel complanatis ad 1.5 m. altis et extrinsecus extensis, cortice cinereo-viridi vel brunneola laevi vel subtiliter fissurata et chartacea, cortice interiore et ligno albo vel flavido brunneo sed post expositionem fuscanti; ramulis gracilibus apicem versus 2–3 mm. latis atro- vel pallido-ferrugineis denique cinereo-fuscis et pallidis; stipulis maturis lanceolatis 12–20 × 4–6 mm. apice acutis vel acuminatis; petiolis gracilibus 15–35 mm. longis 1–2.5 mm. latis semiteretibus vel basi subteretibus et lamina folii basi alatis; foliorum laminis coriaceis lanceolatis vel anguste vel late ellipticis 6–19 cm. longis 1.5–6.5 cm. latis apice obtuse vel raro acutissime acuminatis supra glabris nitidis vel glaucis, subtus glabris, costa conspicua supra plana vel prominula subtus elevata, nervis secundariis utrinsecus 15 ad 20 et utrinque prominulis, nervis tertiariis et rete venularum utrinque prominulis; inflorescentiis sparsim puberulis, subtilibus diffusis ramificationis 2 vel 3 ordinibus et cum usque ad 100 floribus, sub anthesi

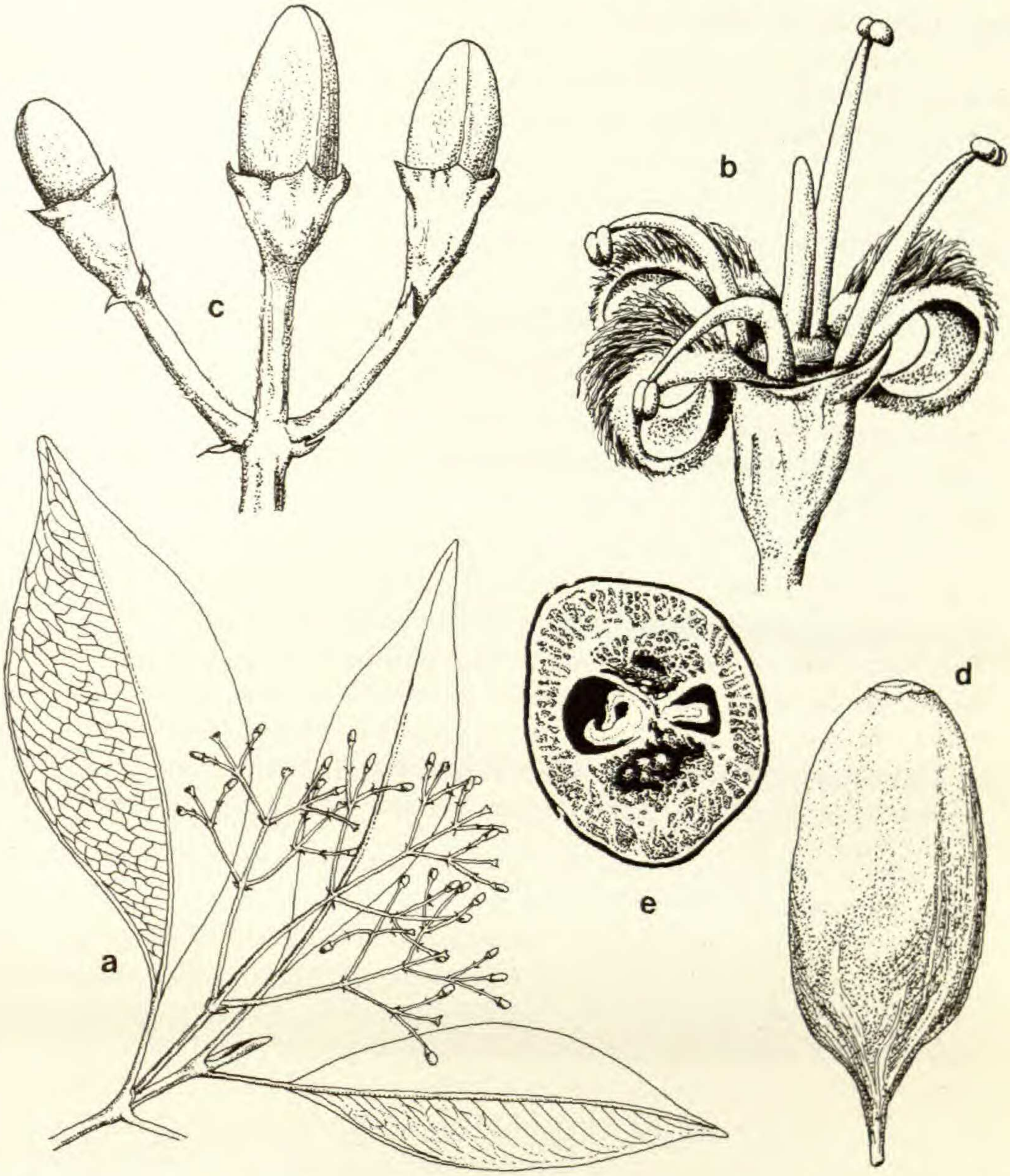


FIGURE 12. *Mastixiodendron plectocarpum*: a, terminal portion of branchlet showing inflorescence shortly before anthesis, × ½ (from *Pullen 7327*); b, flower with one corolla lobe removed, × 10 (from *BW 13347 (Schram)*); c, dichasium with flower buds, × 8 (from *BW 8516 (Kalkman)*); d, fruit, × 2 (from *Kiunga ref. 3*); e, fruit in cross section, × 2 (from *Brass & Versteegh 13563*).

(6–)9–11 × (3–)4–12 cm. sub fructu 7–14 × 4–16 cm., pedunculis gracilibus subteretibus 1.5–4(–5) cm. longis et 1–2 mm. diametro, inflorescentiarum bracteis deltoideis vel ovatis ad 1.5 × 1.5 mm. basi saepe amplectentibus apice obtusis vel acuminatis; pedicellis gracilibus ad 5 mm. longis; calycis limbo 1.5–2 mm. lato, lobis submembranaceis late deltoideis vel ovatis ad 0.8 mm. longis 1–1.5 mm. latis basi aliquantum connatis apice acutis vel obtusis et apiculatis extus glabris vel minute puberulis; corollae limbo 5–8 mm. lato, lobis ellipticis vel oblongis vel ovatis 3–4 mm. longis circiter 1 mm. latis flavo-virentibus extus pilis dispersis stramineisque mi-

nute puberulis vel glabris intus distaliter pilis implexis ad 0.8 mm. longis albis vel stramineis pilosis sed basi glabris; staminum filamentis ad 3.5 mm. longis basi circiter 0.2 mm. latis apicem versus angustatis, antheris 0.3–0.5 mm. longis circiter 0.3 mm. latis; ovarii parte inferiore 1–1.5 × 1–1.5 mm., disco applanato ad 0.5 mm. alto in centro depresso et pilis minutis flavis vel albis circiter 0.1 mm. longis puberulo sed marginem versus glabro; stylo 1.5–2 mm. longo circiter 0.2 mm. diametro apice truncato vel ad 0.3 mm. diviso; fructibus ovoideis vel obovoideis (20–)25–30 mm. longis 10–16 mm. diametro basim versus saepe angustatis apice late rotundatis et perianthii cicatrice coronatis, in vivo pallide viridibus in sicco cinereo-purpureis vel nigris, mesocarpio tenui, endocarpio fibroso cancellato et resina aromatica rubella vel pellucida copiose pleno; seminibus 10–12 × 2–3 mm. pallide ferrugineis glabris et in sicco saepe rugosis et longistrorsum plicatis.

NOMENCLATURE. The type collection of *Mastixiodendron plectocarpum* is *Pullen 7327*; the locality is "near old Niogomban Village, c. 4 mi. S. of D'Albertis Junction, upper Fly River, Western Distr., Terr. of Papua." Specimens with fruits and flowers were gathered from a tree 33.5 meters high growing at an altitude of about 30 meters on low, hilly, forested terrain.

The epithet *plectocarpum* refers to the woven (i.e., strongly cancellate) pericarp by which the fruits of this species are readily distinguished.

DISTRIBUTION AND ECOLOGY. *Mastixiodendron plectocarpum* is distributed from the Geelvink Bay area of West New Guinea (including Japen Island) southeastward to western Papua; its altitudinal range is from 30 to 800 meters. Individuals may be common or occasional in humid lowland to hilly, primary or secondary forests, frequently on sandy or clayey soil. Flowers and fruits have been collected between the months of March and September.

LOCAL NAMES. "Moapi" (Samber), "teitakka" (Manikiong).

West New Guinea. GEELVINK BAY: Japen Island, Seroei, *bb 30311* (L), *bb 30318* (L), *bb 30342* (L), *bb 30355* (A, L), *bb 30463* (L); Japen Island, Biak, Semèni near Seroei, *Aet & Idjan (exped. L. J. van Dijk) 318* (K, L); Japen Island, Aisaoe, *BW 10580 (Schram)* (L); Wondiwoi Mountains, Wandammen Peninsula, *BW 13347 (Schram)* (LAE). DJAJAPURA: Sidoarsi Mountains, about 200 km. west of Hollandia, *BW 7987 (Schram)* (CANB, L, LAE); Idenburg River, Bernhard Camp, *Brass & Versteegh 13563* (A, L); 2 km. southwest of Bernhard Camp, *Brass & Versteegh 13502* (A, BM, L). DIGUL: Omkoeboen, about 60 km. north of Mindiptana, *BW 8516 (Kalkman)* (CANB, L, LAE). **Papua.** WESTERN: upper Fly River, vicinity of old Niogomban Village, about 6.4 km. south of D'Albertis Junction, *Pullen 7327* (CANB, holotype; isotypes at A, L, LAE); road to Rumginae, 4.8 km. north of Kiunga, *NGF 48441 (Foreman & Katik)* (A, BISH, CANB, LAE); Kiunga, *For. Prod. Moresby (Eddowes & Kumul) Kiunga ref. 3* (LAE), *NGF 33429 (Ridsdale & Galore)* (A, BISH, BRI, CANB, K, L, LAE).

Specimens of *Mastixiodendron* from West New Guinea that have fruits with strongly cancellate pericarps and broadly rounded apices were pro-

visionally referred to *M. stoddardii* by Merrill and Perry (1945). Now that many more collections, both fruiting and flowering, are available from that area, it is evident that they have little to do with *M. stoddardii* but represent a separate species, named here *M. plectocarpum*.

Mastixiodendron plectocarpum comprises individuals with delicate, open, relatively few-flowered inflorescences, flowers with more or less oblong buds and flat, puberulent to papillate discs. The fruits are comparatively small, almost entirely inferior, rounded at the apex, and have fibrous pericarps composed largely of resin cavities. The fruits, discs, and flower buds suggest *M. smithii*, to which the present species is probably related. However, in nearly all other characters *M. plectocarpum* remains distinct. It is easily recognized in the vegetative state by its slender branchlets and frequently narrow leaf blades (especially in collections from Japen Island) with the secondary and tertiary nerves hardly distinguishable from one another and prominulous on both surfaces. Leaf blades of similar aspect are found in *M. robustum*, from Fiji, but the reproductive structures of that species are so entirely different as to preclude any close relationship with *M. plectocarpum*.

5. Mastixiodendron robustum A. C. Sm., Pacif. Sci. 23: 390. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 278. 1972. FIGURES 3, 13.

Tree to 25 m. high, the bole to 16 m. high, to 80 cm. d.b.h., the buttresses spreading, the crown spreading to dense and round; bark smooth, brittle, finely fissured, the inner bark yellow, darkening on exposure, the wood white; branchlets 3–5 mm. broad toward apex, dark red-brown, becoming pale brown; mature stipules oblong-lanceolate, 15–30 × 6–10 mm., acute at apex; petioles stout, semiterete to somewhat canaliculate, (12–)18–30(–40) mm. long, 2–3 mm. broad, broadly winged by base of leaf blade; leaf blades thickly coriaceous, oblong-elliptic to obovate, (7–)9–17 cm. long, (2.5–)3.5–8 cm. broad, acute to bluntly acuminate at apex, often somewhat revolute at margin, glabrous and often somewhat glossy above, glabrous beneath, the costa conspicuous, prominulous to canaliculate above, prominulous to raised and rounded beneath, the secondary nerves 12 to 20 per side, prominulous above and beneath, the tertiary nerves and veinlets prominulous above and beneath; inflorescences puberulent with minute, scattered hairs, robust, with 1 to 2 orders of branching and 7 to 50 flowers, 2–7 × 2–3.5 cm. at anthesis, to 7 × 9 cm. in fruit, the peduncles stout, subterete, to 2 cm. long, 3–4 mm. in diameter, the inflorescence bracts caducous, subdeltoid, to 1 × 1 mm., acute to obtuse at apex; pedicels stout, 1–3 mm. long (to 4 mm. in fruit); calyx limb patelliform, (2–)3–4 mm. across, the lobes membranaceous, broadly ovate to 0.5 mm. long, to 2 mm. broad, obtuse to apiculate to rounded at apex, united at base into cup to 0.3 mm. high, essentially glabrous outside; corolla limb about 8 mm. across, the lobes yellow to white, ovate to subdeltoid, 2.5–3.5 mm. long, (1.5–)2.5–3.5 mm. broad, glabrous to puberulent outside with a few scattered hairs, densely puberulent distally inside with tangled, yellow

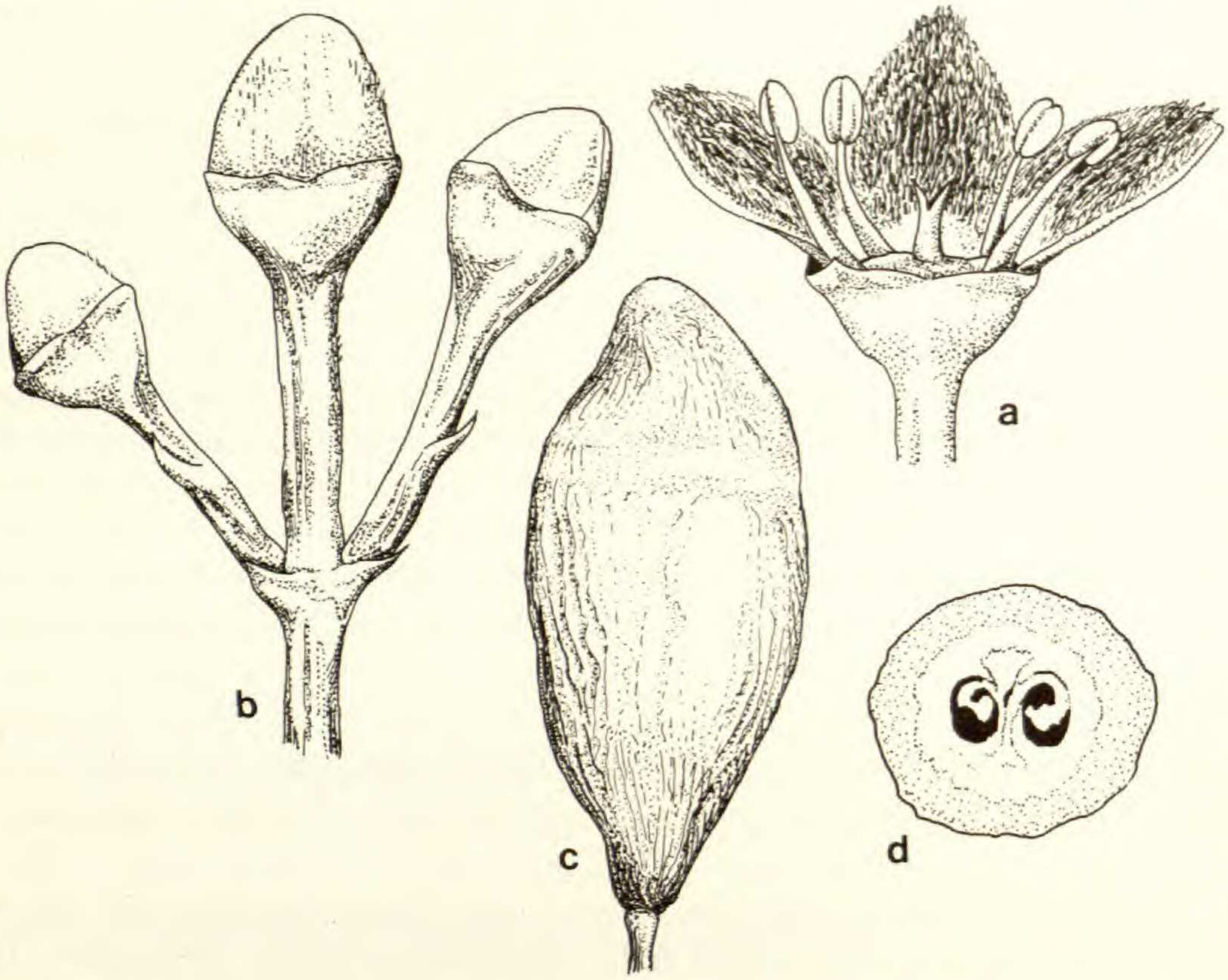


FIGURE 13. *Mastixiodendron robustum*: a, flower with one corolla lobe removed, × 6 (from *Fiji Dept. Agr. L13374*); b, dichasium with flower buds, × 8 (from *Fiji Dept. Agr. L13374*); c, fruit, × 1 (from *W. J. Howard 94*); d, same in cross section, × 1.

hairs to 0.5 mm. long, glabrous toward base; filaments of stamens 1.5–2 mm. long, to 0.5 mm. broad at base, tapering toward apex, the anthers about 0.8 × 0.5 mm.; inferior portion of ovary 1–1.5 mm. long, about 3.5 mm. in diameter, the disc flat to broadly rounded, about 0.5 mm. high, glabrous; style 0.5–1.2 mm. long, about 0.3 mm. in diameter, divided about 0.5 mm. at apex; fruits hard, green to yellowish when alive, drying pale to dark brown, glabrous, ellipsoid to obovoid, (30–)42–55 × (16–)20–26 mm., often tapering toward base, ringed by faint perianth scar 15–20 mm. below rounded to bluntly pointed apex, the mesocarp thin, the endocarp dense, woody, usually without conspicuous resin cavities; seeds 20–35 mm. long, about 3 mm. broad, yellowish brown or orange, wrinkled when dry.

NOMENCLATURE. The type of *Mastixiodendron robustum* is *Fiji Dept. Agr. L13374*, collected near the Waimanu River above Vatuvula, Naitasiri, Viti Levu, at an altitude of 120 meters.

DISTRIBUTION AND ECOLOGY. Endemic to Fiji and known only from the islands of Viti Levu and Vanua Levu. *Mastixiodendron robustum* occurs as a main story tree in forests from near sea level to about 120 meters.

LOCAL NAMES AND USE. I have found the following Fijian names re-

corded: "kauloa" (Viti Levu), "nduvula" (Viti Levu and Vanua Levu). The species is said to yield good, durable timber.

Fiji. VITI LEVU. NAMOSI: Nambukavesi, *Fiji Dept. Agr. 767* (BRI, MASS, SUVA). NAITASIRI: Waimanu River above Vatuvula Village, *Fiji Dept. Agr. L13374* (*Berry 31*, coll. *I. Qoro*) (BISH, holotype; isotypes at K, SUVA). TAILEVU: ridge west of Waisei Village, *Berry 166* (BISH, K, SUVA); Raralevu, *Fiji Dept. Agr. 2667* (BISH, SUVA). REWA: base of Mt. Korombamba, *Fiji Dept. Agr. 1189* (BISH, SUVA). VANUA LEVU. MATHUATA: forests of Mt. Ratinitini, slopes at Seanggangga, *Fiji Dept. Agr. 486* (*Loweth 2256*) (K, SUVA); inland from Lambasa, *Fiji Dept. Agr. 238* (*I. Bola 86*) (BISH, SUVA). THAKAUNDROVE: Navonu Creek, Natewa Peninsula, *W. J. Howard 94* (BISH, K, SUVA). FIJI, without further locality, *E. Damanu NI–32* (K).

This distinct Fijian species has been well discussed by Smith (cited above), and thus its diagnostic characters need only be outlined here. *Mastixiodendron robustum* is readily distinguished by its thickly coriaceous leaf blades with relatively numerous, prominulous secondary nerves. In addition, the branchlets and the reproductive parts are generally more robust than are those of the other Fijian species, as suggested in the key.

Certain specimens of *Mastixiodendron flavidum* approach *M. robustum* in vegetative characters but have the open, freely branched inflorescences and smaller flowers characteristic of the former species. Although the leaf blades of *M. pilosum* are as large as or larger than those of the present species, they are much thinner in texture and pubescent on their lower surfaces; besides many differences in the morphology of their flowers, *M. pilosum* and *M. flavidum* further disagree with the present species in their differently shaped and thinner-walled fruits.

6. Mastixiodendron flavidum (Seem.) A. C. Sm., Jour. Arnold Arb. 26: 109. 1945; J. W. Parham, Pl. Fiji Isl. 197. 1964, ed. 2. 277. 1972. FIGURES 2; 14, a–e.

Rubiacearum gen. (*nov. ?*) Seem., Bonplandia **9**: 257. 1861.
Canthium aff. *lucidum* sensu A. Gray, Proc. Am. Acad. Arts Sci. **5**: 319. 1862. Bonplandia **10**: 36. 1862; non Hooker & Arn.
Canthium flavidum Seem., Fl. Vit. 132. 1866.
Plectronia flavida Bentham & Hooker f. ex Drake, Fl. Ins. Mar. Pac. 194. 1890.
Dorisia rarissima Gillespie, Hooker's Icon. Pl. **32**: *t. 3190*. 1933.
Dorisia flavida A. C. Sm., Bishop Mus. Bull. **141**: 140. 1936; Fosberg, Sargentia **1**: 120. 1942.

Spreading to slender tree or shrub to 20 m. high; branchlets 1.5–3 mm. broad toward apex, dark red-brown, becoming pale brown; mature stipules lanceolate to ovate, 8–22 × 6–8 mm., acuminate at apex; petioles semiterete to somewhat canaliculate, 7–28(–50) mm. long, 1–1.8(–3) mm. broad, winged by base of leaf blade; leaf blades coriaceous, elliptic to oblong-elliptic to obovate, 4–17(–21) cm. long, (1.5–)2–8(–12) cm. broad, obtuse to bluntly acuminate at apex, often somewhat revolute at margin, glabrous and glossy to glaucous above, glabrous or rarely finely puberulent beneath

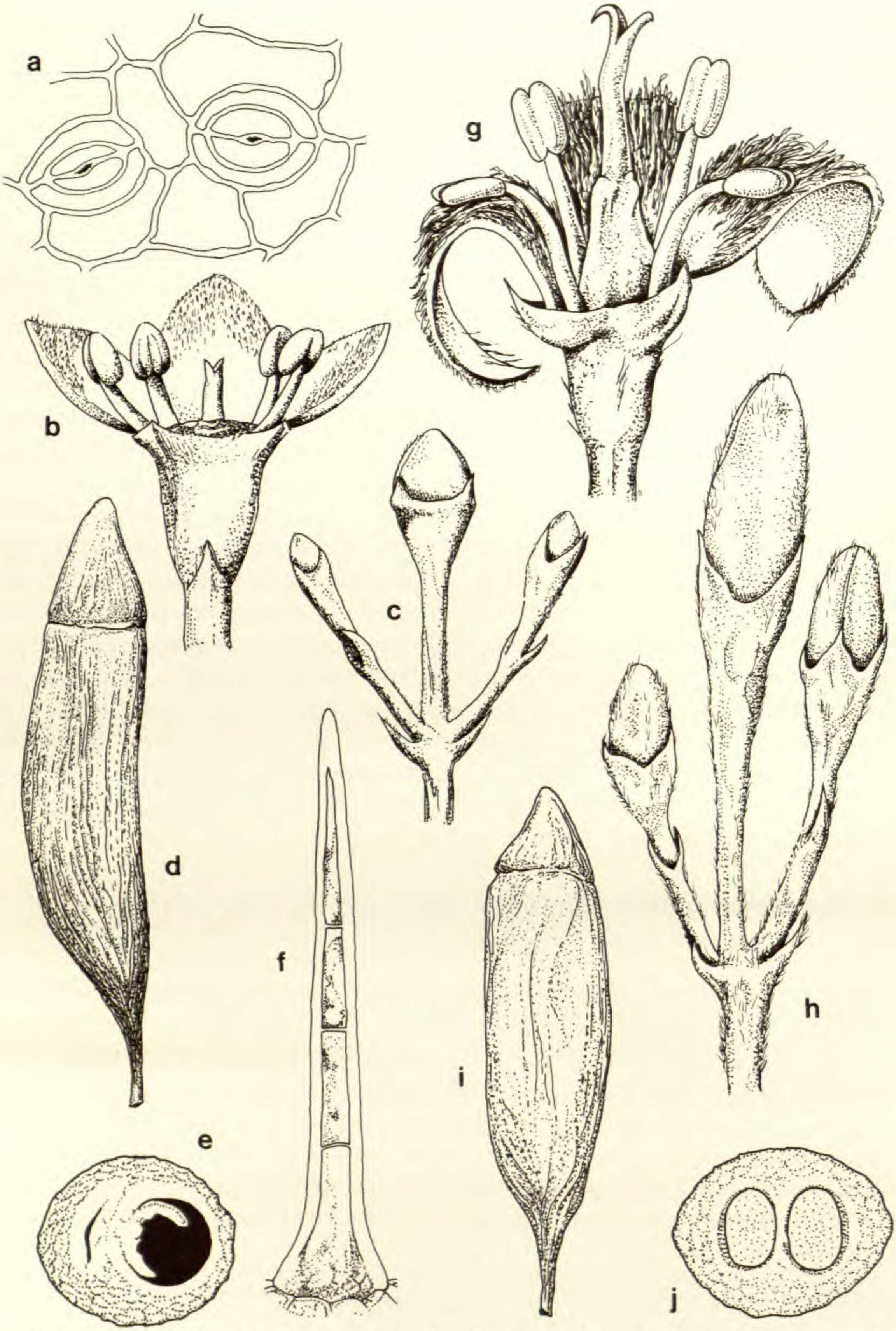


FIGURE 14. a–e, *Mastixiodendron flavidum*: a, view of abaxial surface of leaf blade showing pair of stomata, × 500 (from *A. C. Smith 6365*); b, flower with one corolla lobe removed, × 10 (from *A. C. Smith 6365*); c, dichasium with flower buds, × 8 (from *Fiji Dept. Agr. 15242*); d, fruit, × 2 (from *A. C. Smith 1790*); e, same in cross section, showing developed and aborted seeds, × 3. f–j, *Mastixiodendron pilosum*: f, trichome from abaxial surface of leaf blade showing relatively thick wall and thinner partitions, × 300 (from *H. B. R.*

with minute, scattered hairs about 0.2 mm. long, the costa conspicuous, plane to prominulous above, raised and rounded beneath, the secondary nerves 7 to 12(to 15) per side, prominulous above and beneath, the tertiary nerves and veinlets prominulous to plane above and beneath; inflorescences puberulent with scattered, minute hairs, delicate, open, with 1 or 2 (rarely 3) orders of branching and as many as 70 flowers, 4–10.5(–15) × 2.5–9.5 cm. at anthesis, 6–17 × 4–14 cm. in fruit, the peduncles slender, (2–)4–9 cm. long, to 1.5 mm. in diameter, the inflorescence bracts deciduous, deltoid, to 1.5 × 0.8 mm., obtuse to acute at apex, often clasping at base, sometimes erosulous at margin; pedicels slender, 1–3(–5) mm. long; calyx limb cupular, 1.5–2.5 mm. across, the lobes membranaceous, deltoid, 0.3–0.8(–1.2) mm. long, 0.5–1 mm. broad, obtuse to acuminate at apex, united at base into tube about 0.2 mm. high, glabrous to almost imperceptibly puberulent outside; corolla limb about 4 mm. across, the lobes white to orange to pale yellow, ovate to suborbicular, 1.5–2.5 mm. long, 1.5–2 mm. broad, obtuse to acute at apex, glabrous to finely puberulent outside with a few scattered hairs, densely puberulent to papillate distally inside with minute, yellow hairs about 0.1 mm. long, glabrous toward base; filaments of stamens 0.8–1 mm. long, about 0.2 mm. broad at base, tapering toward apex, the anthers about 0.5 mm. long, 0.3–0.5 mm. broad; inferior portion of ovary 1–1.5 × 1–1.5 mm., the disc broadly rounded, to 0.4 mm. high, glabrous; style caducous, 0.5–0.8 mm. long, about 0.3 mm. in diameter, truncate or divided about 0.2 mm. at apex; fruits green to yellow to orange, drying red-brown to nearly black, glabrous and often glaucous, broadly fusiform to long-obovoid, sometimes oblique, 20–32 × 6–8(–11) mm., tapering at both ends, the perianth scar 2–8 mm. below apex, the mesocarp thin, fleshy, the endocarp woody to coarsely fibrous, to 2 mm. thick, without conspicuous resin cavities; seeds about 12 × 3 mm., dark orange-yellow, wrinkled when dry.

NOMENCLATURE. Seemann based his description of *Canthium flavidum* on his own (flowering) collection, number *256*, cited below. The locality given on the holotype is "Matuata" (Mathuata, Vanua Levu), while that on the isotypes is Fiji, without further locality. The type of *Dorisia rarissima* is *Greenwood 517*, the collection on which Gillespie based his description, and known only from the holotype. It is a flowering specimen gathered near Lambasa (Mathuata, Vanua Levu) September 17, 1922, from a tree about 6 meters high growing at the edge of a clearing at an altitude of about 150 meters.

DISTRIBUTION AND ECOLOGY. *Mastixiodendron flavidum* is endemic to Fiji, where it has been collected on the islands of Viti Levu, Vanua Levu, and Rambi, and at altitudes from near sea level to about 1000 meters.

Parham III); g, flower with one corolla lobe removed, × 10 (from *Fiji Dept. Agr. 17094*); h, dichasium with flower buds, × 8 (from *Fiji Dept. Agr. 17094*); i, fruit, × 2 (from *A. C. Smith 6781*); j, same in cross section showing two developed seeds, × 3.

Isolated individuals are encountered in a variety of habitats, from high, dense, montane forests to dry, open, coastal forests and thickets. Flowering and fruiting specimens have been gathered throughout the year.

LOCAL NAMES. "Tembatemba" and "tuva ni viti" (Viti Levu), "reiova" (Vanua Levu), "kauloa" (Parham, 1972, cited above).

Fiji. VITI LEVU. MBA: Mt. Evans Range between Mt. Vatuyanitu and Mt. Natondra, *A. C. Smith 4368* (A, BISH, K, L, NY, US); vicinity of Nandarivatu, *Degener & Ordonez 13579* (A, BISH, K, L, NY, SUVA, US), *Gillespie 3870* (BISH), *A. C. Smith 5742* (A, BISH, BRI, K, L, NY, US); Navai Tea Block, *Fiji Dept. Agr. 14978* (BISH, BRI, K, LAE, SUVA); Mt. Tomanivi, *Lam 6845* (L). NANDRONGA & NAVOSA: Rairaimatuku Plateau between Nandrau and Nanga, *A. C. Smith 5561* (A, BISH, BRI, K, L, NY, US); Nandevondevo, near Vanualevu, *Fiji Dept. Agr. 1183* (BISH, SUVA). SERUA: coastal strip near Ngaloa, *A. C. Smith 9690* (BISH, GH, K, L, NY, SUVA, UC, US). NAMOSI: Mt. Vakarongasiu, *Fiji Dept. Agr. 16128* (L, SUVA). VANUA LEVU. MATHUATA: Nasealevu, Sasa, *Fiji Dept. Agr. 15242* (A, BRI, K, MASS, NY, SUVA, UC); southern slopes of Mt. Numbuiloa, east of Lambasa, *A. C. Smith 6365* (A, BISH, K, L, NY, US), *A. C. Smith 6444* (A, BISH, BRI, K, L, NY, US); vicinity of Lambasa, *Greenwood 517* (K, holotype of *Dorisia rarissima*); Mathuata, without further locality, *Seemann 256* (K, holotype of *Canthium flavidum*; isotypes at BM, GH). THAKAUNDROVE: Yanawai River region, Mt. Kasi, *A. C. Smith 1790* (BISH, GH, K, NY, US); mountains between Waiwai and Lomaloma, *Horne 608* (K); Vunimoli, Vaturamulo, *Fiji Dept. Agr. 15396* (BISH, LAE, SUVA); track to Mt. Nasorolevu, Savusavu, *Fiji Dept. Agr. 17141* (BISH, K, SUVA); Mt. Mariko, *A. C. Smith 430* (BISH, GH, K, NY, US); hills west of Korotasere, *A. C. Smith 1932* (BISH, GH, K, NY, US). RAMBI: mountains of Rambi, *Horne 441* (K).

The present species is reasonably distinct in its delicate branchlets, relatively small leaves, and open inflorescences. The flowers are the smallest of the genus, the corolla lobes are papillate to finely pubescent on their inner surfaces, and the discs are broad and glabrous.

The closest relative of *Mastixiodendron flavidum* is evidently *M. pilosum*; indeed, the fruits of those two taxa are hardly distinguishable. *M. pilosum* differs primarily in the lower surfaces of its leaf blades, which are persistently pubescent rather than glabrous, and in the longer flower buds, corolla lobes, stamen filaments, styles, and discs. However, in spite of those distinctions, a close relationship between *M. pilosum* and *M. flavidum* is further suggested by at least one collection (*Fiji Dept. Agr. 15242*) in which the relatively large leaf blades are pubescent, although the inflorescences and flowers are like those of *M. flavidum*. Another fruiting collection (*Fiji Dept. Agr. 15396*) has chartaceous and exceptionally large leaf blades, but because they are glabrous I have assigned it to the present species; it may represent material collected from sucker shoots.

The relationship of *Mastixiodendron flavidum* to *M. robustum* also seems close (as suggested by pollen morphology), although the flowers and fruits of the latter species are of a much larger size and an entirely different shape. In a few collections (e.g., *A. C. Smith 9690*), the leaf blades are thickly coriaceous and the branchlets particularly robust, although the

inflorescences and flowers appear to me to be definitely of the *M. flavidum* type.

7. **Mastixiodendron pilosum** A. C. Sm., Jour. Arnold Arb. **26**: 109. 1945, *op. cit.* **34**: 99. 1953; J. W. Parham, Pl. Fiji Isl. 198. 1964, ed. 2. 278. 1972. FIGURES 5; 14, f–j.

Slender tree to 10 m. high, the bole relatively short, to 75 cm. d.b.h.; branchlets 2.5–4(–6) mm. broad toward apex, red-brown to brown, densely puberulent when young; mature stipules broadly subulate to lanceolate, 17–24 × 3–6 mm., acuminate at apex, glabrous or finely puberulent with a few scattered hairs; petioles semiterete to subterete and somewhat canaliculate, 20–40 mm. long, 1.5–2.5 mm. broad, densely to finely puberulent with scattered hairs; leaf blades subcoriaceous to chartaceous, elliptic to oblong, (9–)12–24 cm. long, (3.5–)5–14 cm. broad, obtuse to rounded and bluntly cuspidate at apex, often somewhat revolute at margin, glabrous and glossy to glaucous above, pilose to tomentulose beneath with scattered, spreading, brown to stramineous hairs to 0.7 mm. long, the costa conspicuous, plane to raised and canaliculate above, raised and rounded beneath, the secondary nerves 8 to 11 per side, prominulous above, raised and rounded beneath, tertiary nerves and veinlets prominulous above and beneath; inflorescences puberulent with minute, scattered hairs, delicate, open, with 1 to 3 orders of branching and 25 to 55 flowers, 10–14 × 2–8 cm. at anthesis, 10–15 × (6–)8–11 cm. in fruit, the peduncles slender, subterete, 2.5–7 cm. long, 1–1.5 mm. in diameter, the inflorescence bracts caducous, deltoid to lanceolate, to 1.5 mm. long, to 0.5 mm. broad, acuminate at apex, often somewhat clasping at base; pedicels slender, 1–3(–5) mm. long; calyx limb cupular, 1.5–2.5 mm. across, the lobes coriaceous, deltoid, (0.5–)1–1.5 mm. long, 0.5–1 mm. broad, acute to acuminate at apex, united at base into shallow cup to 0.5 mm. high, puberulent outside with scattered hairs; corolla limb about 8 mm. across, the lobes yellow, long-elliptic to lanceolate, 4–4.5 mm. long, 1.2–1.8 mm. broad, puberulent outside with scattered hairs, densely puberulent distally inside with yellow hairs to 0.5 mm. long, glabrous toward base; filaments of stamens 1–2 mm. long, about 0.2 mm. broad at base, tapering toward apex, the anthers about 0.8 × 0.5 mm.; inferior portion of ovary 1.5–2 × 1–1.5 mm., the disc subconical, about 1.5 mm. high, blunt at apex, glabrous; style 1.5–2 mm. long, about 0.3 mm. in diameter, truncate to somewhat thickened at apex, not divided; fruits dull yellow to orange, drying dark orange to nearly black, glabrous, broadly fusiform to long-obovoid, sometimes oblique, 25–32 × 6–9 mm., usually tapering at both ends, the perianth scar 4–6 mm. below apex, the mesocarp thin, fleshy, the endocarp woody to coarsely fibrous, to 0.3 mm. thick, not especially resinous; seeds 8–13 × 1.5–2 mm., red-brown, glabrous.

NOMENCLATURE. The type of *Mastixiodendron pilosum* is *Horne 1132*, collected from a tree in a dry forest, September, 1878. The locality given

on the holotype is Fiji, without further information; the isotype reads "District of Bua [Mbua], Vanua Levu."

DISTRIBUTION AND ECOLOGY. Endemic to Fiji; collected on the islands of Viti Levu and Vanua Levu. *Mastixiodendron pilosum* occurs in dry, dense forests at altitudes from near sea level to 250 meters. Flowers and fruits have been gathered between the months of September and January. The wood is said to be hard, close-grained, and durable.

Fiji. VITI LEVU. NAMOSI: Wainandoi River valley, *Fiji Dept. Agr. 17094* (BISH, BRI, K, SUVA). VANUA LEVU. MBUA: between Mbua and Ndevoka, *H. B. R. Parham III* (A); Mbua, without further locality, *Horne 1132* (GH, holotype; isotype at K). MATHUATA: southern base of Mathuata Range, north of Natua, *A. C. Smith 6781* (A, BISH, BRI, K, L, NY, US).

The type collection of *Mastixiodendron pilosum* bears immature fruits which are essentially identical with those of *M. flavidum*. However, the leaf blades are generally larger, chartaceous rather than coriaceous, and bear a persistent indument on the lower surfaces. The petioles and young branchlets are also pubescent. Gillespie (1933) aligned the type collection with *M. flavidum*, but Smith (1945, cited above) segregated it and one other fruiting collection as *M. pilosum*, based primarily on the indument characters just mentioned. Since the first description of *M. pilosum*, specimens with immature and mature flowers have become available which strongly support the recognition of the present species as distinct from *M. flavidum*. The flowers of *M. pilosum* differ in their long-ellipsoid rather than subglobose buds, their longer corolla lobes puberulent on the inner surfaces with longer hairs, and their longer stamen filaments and styles. The discs are also subconical, instead of rounded, as in *M. flavidum*, and are similar in shape to those of *M. smithii* (although in numerous other characters of flowers and fruits the latter species is quite different).

The relationship of the present species with *Mastixiodendron robustum* would seem remote on the basis of floral and vegetative morphology, the latter species differing in its more thickly coriaceous leaf blades, more robust branchlets, and fewer-flowered inflorescences with larger, differently shaped flowers, among other more technical characters. However, as mentioned previously, a similarity in pollen morphology indicates that the three Fijian species (*M. robustum*, *M. flavidum*, and *M. pilosum*) are in fact closely related, as is also suggested by a few collections which are intermediate in their vegetative characters both between *M. robustum* and *M. flavidum*, and between *M. flavidum* and the present species.

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collections available (abbreviations after Holmgren & Keuken, 1974): A, BISH, BM, BRI, CANB, GH, K, L, LAE, MASS, MO, NY, SUVA, UC, US. Wood specimens were obtained from the Harvard Wood Collection.

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